

**Test Report**  
**of**  
**PN420 Test Transmission**  
**at Temple Hill**

**Jointly Submitted by**  
**Radio Television Hong Kong**  
**Television Broadcasts Limited**  
**Asia Television Limited**

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## 1 Executive Summary

The test is jointly conducted by RTHK, ATV and TVB from 24<sup>th</sup> September to 1<sup>st</sup> November 2012. It aims at comparing the reception reliability of two modes of frame header PN420 and PN945 at tidal fading areas in Hong Kong.

In finite bandwidth of a current TV channel (8 MHz), use of PN420 instead of PN945 is a fastest method<sup>1</sup> to contribute more bit-rate without involving extra transmission and reception facilities. In general, the receiving performance between PN420 and PN945 in Multiple Frequency Network (MFN) is close no matter line of sight or shadow conditions but PN420 performing a bit worse in tidal fading environment. In order to find out the level of reliability of two modes of frame header PN420 and PN945 at those areas where currently suffered from tidal fading phenomenon, we use two type of tailor made receivers to evaluate the receiving performance of grandfather type and latest type chipsets.

The result helps to analyze the reliability (system reliability in general and reception reliability in particular) due to change of transmission parameter from PN945 to PN420.

## 2 Methodology

Four tailor made test receivers provided by brand A and brand B chipset manufacturer are specially made for the test. Two test receivers used grandfather type chipset to simulate general performance of set top box market in 2007 and 2008 whilst two test receivers used latest type chipset to simulate performance in new set top box or idTV after 2009. Four test receivers can output the frame status for analysis purpose.

Tidal cycle occurs 2 times a day, i.e. 12 hours per cycle. The recording of frame status can continuously indicate the effect of TV signal due to tidal fading over the whole tidal period. In this test, 9 survey locations spread over northern part of HK Island and Outline Islands are selected for measuring the TV signal from Temple Hill Station (CH62, 802 MHz). It can be classified to four scenarios, e.g. short distance over harbour, long distance over harbour, typical residential near seaside and severe tidal fading.

The test period for each survey location lasted three days. Inside the period, the frame header PN420 and PN945 will be selected for transmission for 48 hours and 24 hours continuously.

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<sup>1</sup> Under same transmission parameter, 64QAM, CR 0.6, 3780 carriers, the bit-rate can be increased from 21.658 to 24.365 Mbps if PN945 is replaced by PN420.

2.1 Survey locations are listed in following tables:

Table 1: Survey Location

Pt. No.	Survey Location	Latitude Longitude	Scenario
1	Sai Wan Shan Transposer Station	22°16' 20.65" 114°14' 7.06"	Short distance over harbour
2	Pottinger Peak Transposer Station	22°15' 19.58" 114°14' 47.37"	
3	Mt. Nicholson Transposer Station	22°15' 34.13" 114°11' 9.05"	
4	Cheung Chau Transposer Station	22°12' 5.23" 114°1' 35.71"	Long distance over harbour
5	Nam Shan Transposer Station	22°14' 59.32" 113°59' 23.41"	
6	Building Roof at Kennedy Town 西寧街 (西寧閣)	22°16' 52.68" 114°7' 14.74"	Typical residential near seaside
7	Building Roof at North Point 英皇道 (Kiu Kwan Mansion, 僑冠大廈)	22°17' 28.95" 114°11' 57.31"	
8	Cadogan Street, Sai Wan (加多近街海邊)	22°17' 0.81" 114°7' 33.74"	Severe tidal fading
9	Hoi Yu Street, Quarry Bay (HKE Pole No. 47718)	22°17' 26.41" 114°12' 46.14"	

## 2.2 Map of Survey Location

Fig 1: Map of Survey Location



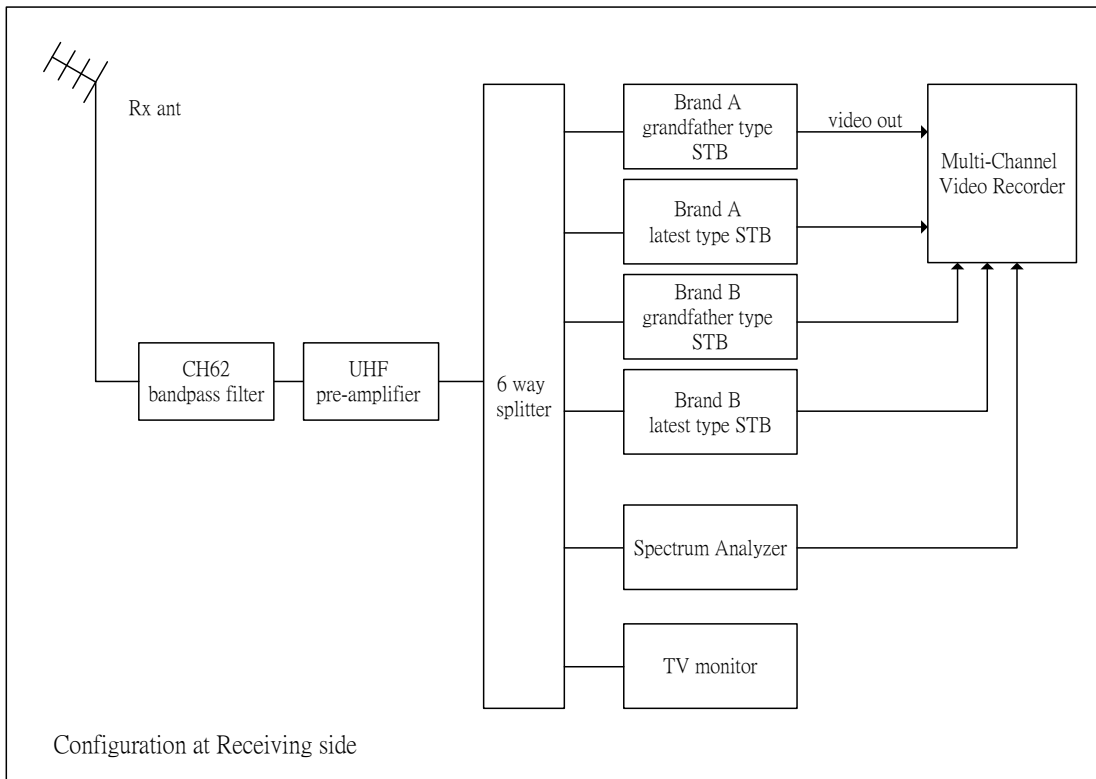
## 2.3 Transmission Parameter

Table 2: Transmission Parameter

TX station:	Temple Hill
E.R.P.:	1 KW
Polarization:	Horizontal
TX channel:	CH62
Frequency:	802 MHz
Standard GB20600-2006	PN945 or PN420
	64 QAM
	CR 0.6
	B=52 M=720

## 2.4 Block Diagram of Test Equipment

Fig 2: Block Diagram of Test Equipment at Receiving Side



### 3 Measurement Result

In order to get more data on reception performance of PN420 under tidal fading, double measured time was held in comparing with PN945. In the test period of PN420 and PN945, 4 complete tidal cycles (48 hours) and 2 complete cycles (24 hours) will be encountered at each location.

Table 3: Summary Table of Measured Result

Pt. No.	Survey Location	PN mode	Brand A						Brand B					
			Grandfather chipset			Latest chipset			Grandfather chipset			Latest chipset		
			Error count	Total count	Avail-ability	Error count	Total count	Avail-ability	Error count	Total count	Avail-ability	Error count	Total count	Avail-ability
Short Distance Over Harbour														
1	Sai Wan Shan	PN420	0	173,710	100.0%	0	71,320	100.0%	0	70,015	100.0%	0	70,073	100.0%
	Transposer Station	PN945	0	86,719	100.0%	0	60,240	100.0%	see remark			0	34,961	100.0%
2	Pottinger Peak	PN420	0	173,056	100.0%	12	62,295	100.0%	0	70,025	100.0%	0	69,999	100.0%
	Transposer Station	PN945	0	87,430	100.0%	47	60,577	99.9%	see remark			0	34,962	100.0%
3	Mt. Nicholson	PN420	0	172,787	100.0%	25	62,295	100.0%	0	69,899	100.0%	0	69,832	100.0%
	Transposer Station	PN945	0	88,607	100.0%	1	61,090	100.0%	see remark			0	35,901	100.0%
Long Distance Over Harbour														
4	Cheung Chau	PN420	12	173,196	100.0%	8	66,194	100.0%	1	70,047	100.0%	12	70,078	100.0%
	Transposer Station	PN945	0	86,414	100.0%	0	60,147	100.0%	see remark			0	34,970	100.0%
5	Nam Shan	PN420	1,078	172,837	99.4%	0	61,794	100.0%	7	69,956	100.0%	1	69,958	100.0%
	Transposer Station	PN945	0	86,423	100.0%	0	60,242	100.0%	see remark			0	34,972	100.0%
Typical Residential Near Seaside														
6	Building Roof at Kennedy	PN420	0	172,810	100.0%	0	61,793	100.0%	46	69,953	99.9%	0	69,992	100.0%
	Town, Sai Ning St (西寧閣)	PN945	3,835	86,425	95.6%	285	58,321	99.5%	see remark			0	35,109	100.0%
7	Building Roof at King's	PN420	0	172,816	100.0%	13	58,473	100.0%	0	69,964	100.0%	0	69,963	100.0%
	Rd., North Point (橋冠大廈)	PN945	0	86,426	100.0%	0	59,842	100.0%	see remark			0	35,005	100.0%
Severe Tidal Fading														
8	Cadogan Street, Sai Wan	PN420	39,945	172,837	76.9%	513	60,017	99.1%	675	69,925	99.0%	369	69,918	99.5%
	(near seaside)	PN945	3,835	86,425	95.6%	154	59,888	99.7%	see remark			0	34,963	100.0%
9	Hoi Yu Street, Quarry Bay	PN420	2,685	172,736	98.4%	52	58,632	99.9%	136	69,795	99.8%	932	68,810	98.6%
	(HKE Pole No. 47718)	PN945	480	86,661	99.4%	0	60,304	100.0%	see remark			0	35,143	100.0%

Remarks:

1. The engineering type test receiver of brand B is tailor made for receiving PN420 only.
2. The survey location at Cadogan Street in Sai Wan (pt. 8) is selected as reference for worst case. The receiving antenna is positioned close to coastline and just a few meters above sea-level. It is absolutely not commended to set up receiving antenna like this because the reflected wave from seawater will almost be 100% received by antenna.

### 3.1 Analysis of Performance of PN420 and PN945

#### 3.1.1 Compared by Grandfather Type Chipset

Table 4: Summary of Grandfather Type Chipset

	Fading Scenarios	Brand	Average Availability (%)		Deviation (%)	Remark
			PN420	PN945		
1	Short Distance Over Harbour (pt 1 - 3)	A	100.0	100.0	0.0	
		B	100.0	N.A.	N.A.	
2	Long Distance Over Harbour (pt 4-5)	A	99.7	100.0	0.3	
		B	100.0	N.A.	N.A.	
3	Typical Residential Near Seaside (pt 6-7)	A	100.0	97.5	-2.5	Improved
		B	100.0	N.A.	N.A.	
4	Severe Tidal Fading (pt 8-9)	A	87.7	97.5	9.8	
		B	99.4	N.A.	N.A.	

The largest deviation (9.8%) occurred at scenario 4 (severe tidal fading) is caused by worst case at Cadogan Street (pt 8). The average availability is pulled down to 87.7% due to relatively low availability at this point (76.9%). Fortunately, this point is only for reference and no receiving antenna will practically install at the place where so close to seaside. Apart from this point, the general figure of average availability of other scenario (1, 2 and 3) is over 99%. No significant degradation is observed.

There is an interesting point at scenario 3 (typical residential near seaside). The availability of PN420 at roof top of building at Sai Ning Street (pt. 6) is better than PN945. This phenomenon also occurred not only in grandfather type chipset but also in latest type that will be shown in later paragraph (3.1.2).

Table 5: Deviation of Availability by Brand

Brand	Average Availability Over 4 Scenarios	Availability (%)
A	PN420	96.9
	PN945	98.8
	Difference between 2 modes	1.9
B	PN420	99.9
	PN945	N.A.



In grandfather type chipset, it seems that the performance of brand A is a bit inferior to brand B but PN420 still reach 96.9% availability. The loss of availability is only 1.9%. If we omit the result of point 9, the availability between 2 modes becomes similar.

### 3.1.2 Compared by Latest Type Chipset

Table 6: Summary of Latest Type Chipset

No.	Fading Scenarios	Brand	Average Availability (%)		Deviation (%)	Remark
			PN420	PN945		
1	Short Distance Over Harbour (pt 1 - 3)	A	100.0	100.0	0.0	
		B	100.0	100.0	0.0	
2	Long Distance Over Harbour (pt 4-5)	A	100.0	100.0	0.0	
		B	100.0	100.0	0.0	
3	Typical Residential Near Seaside (pt 6-7)	A	100.0	99.8	-0.2	Improved
		B	100.0	100.0	0.0	
4	Severe Tidal Fading (pt 8-9)	A	99.5	99.9	0.4	
		B	99.1	100.0	0.9	

For those receivers used latest type chipset, it seemed that the use of PN420 or PN945 will not significantly affect the reception performance even in severe tidal fading environment. The average availability for 2 brand receiver is far better than 99%.

Table 7: Deviation of Availability by Brand

Brand	Average Availability Over 4 Scenarios	Availability (%)
A	PN420	99.9
	PN945	99.9
B	PN420	99.8
	PN945	100.0

In latest type chipset, the availability of two modes is very close. The use of PN420 or PN945 will not affect the reception.

## **4 Conclusion**

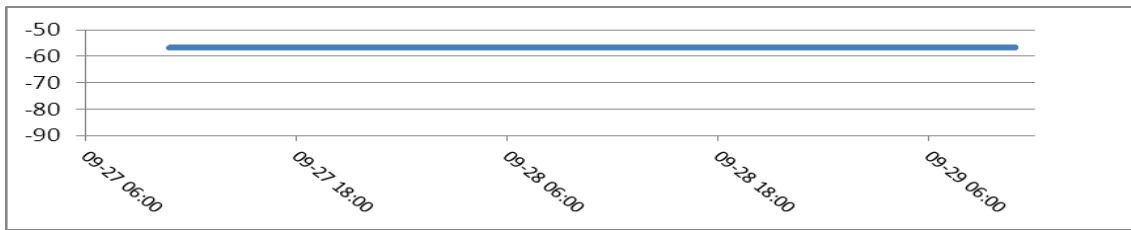
- 4.1 Comparing to the first generation set-top box, the improvement of receiving performance in latest generation set-top box is notable in both PN420 and PN945.
- 4.2 The performance of PN420 is closed to PN945 under latest type chipset. Overall availability of both PN420 and PN945 is better than 99.8%. The figure is much higher than standard technical requirement of 99%.
- 4.3 The change of frame header from PN945 to PN420 for MFN can simply increase about 10% payload (2.71 Mbps) without involving extra transmission equipment. The broadcasters can apply new configuration to the network shortly so the audiences may enjoy better picture quality due to increase of bit rate.

## **6 Appendix: Plot of PN420 and PN945 for 9 Survey Points**

- 5.1 In tidal fading environment, the signal level will fluctuate high and low periodically (due to level of tide) or randomly (due to ripple of wave). In general case, the receiver will be affected if signal level fallen below the threshold of receiver. Micro-block or freeze picture will be observed. Due to better usage of limited recording range, any measured signal at input of test receiver higher than -55 dBm will be flatted.
- 5.2 The reception status “0” means normal reception while status “1” means frame error occurred.

### 5.1a Plot of Point 1 - Sai Wan Shan Transposer Station (PN420)

#### 5.1a.1: Input Level (dBm)



#### 5.1a.2: PN420 Brand A grandfather type



#### 5.1a.3: PN420 Brand A latest type



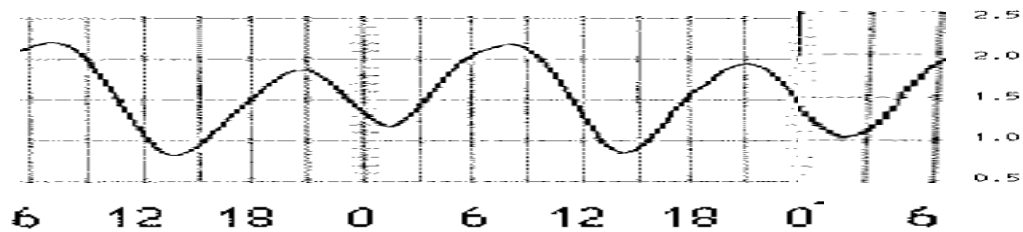
#### 5.1a.4: PN420 Brand B grandfather type



#### 5.1a.5: PN420 Brand B latest type

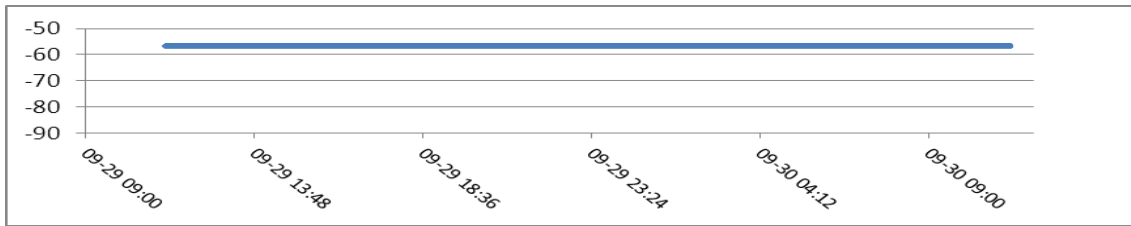


#### 5.1a.6: Tidal Chart from Observatory

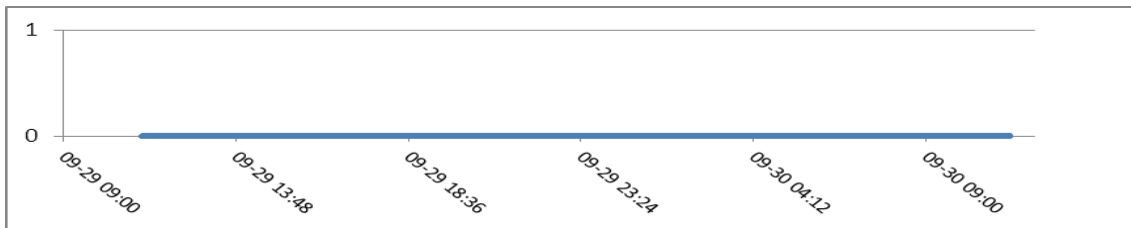


## 5.1b Plot of Point 1 - Sai Wan Shan Transposer Station (PN945)

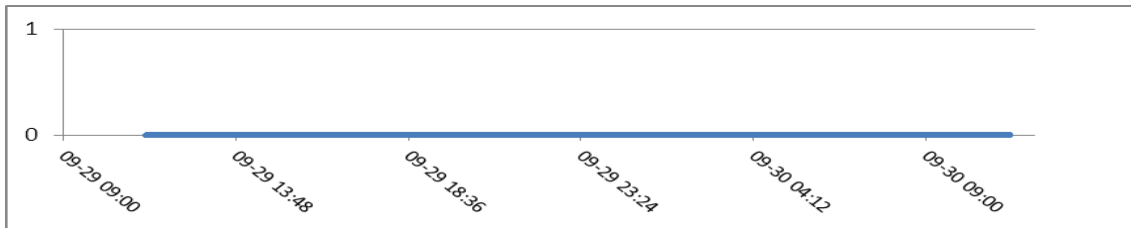
### 5.1b.1: Input Level (dBm)



### 5.1b.2: PN945 Brand A grandfather type



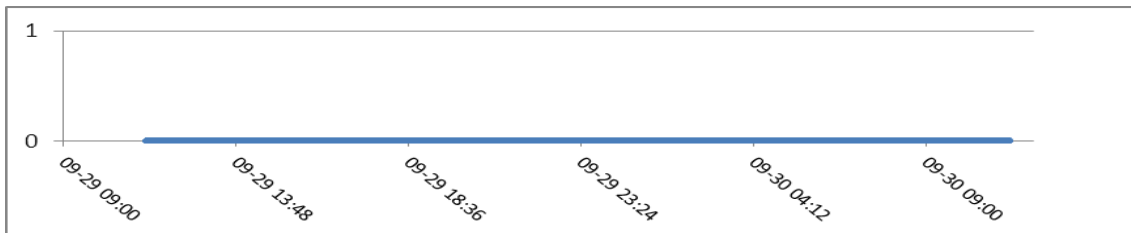
### 5.1b.3: PN945 Brand A latest type



### 5.1b.4: PN945 Brand B grandfather type

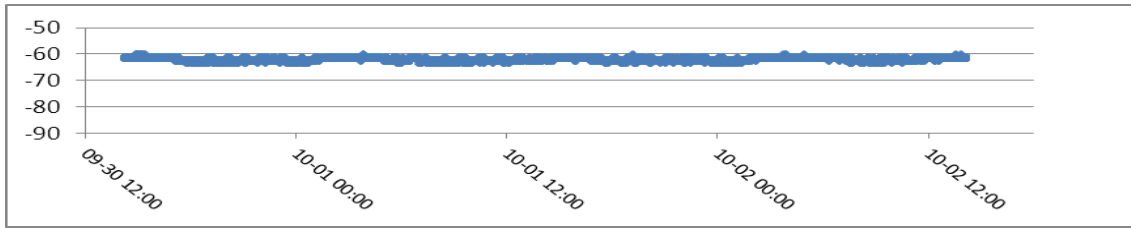
N.A.

### 5.1b.5: PN945 Brand B latest type



## 5.2a Plot of Point 2 – Pottinger Peak Transposer Station (PN420)

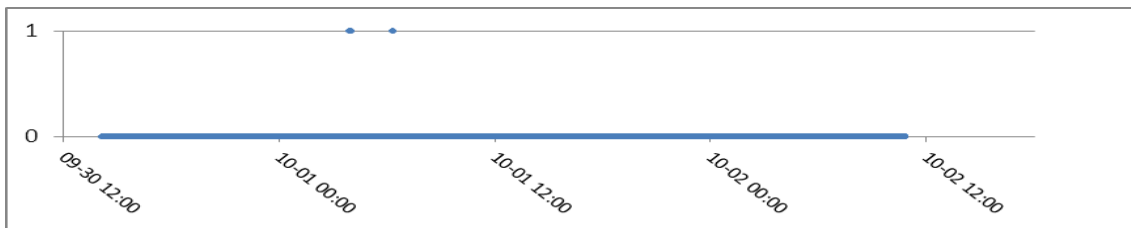
### 5.2a.1: Input Level (dBm)



### 5.2a.2: PN420 Brand A Grandfather Type



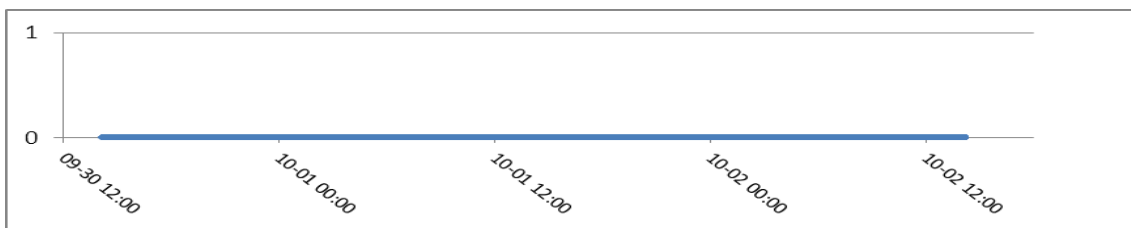
### 5.2a.3: PN420 Brand A Latest Type



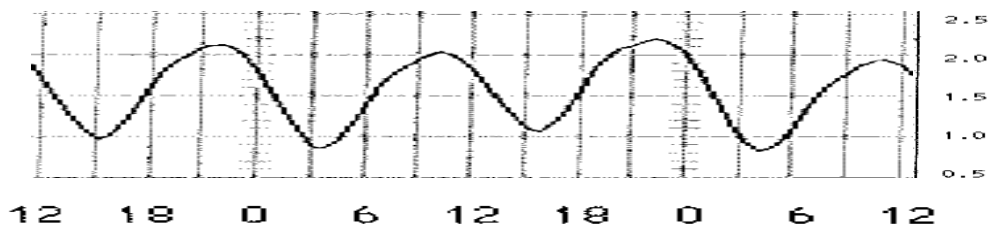
### 5.2a.4: PN420 Brand B Grandfather Type



### 5.2a.5: PN420 Brand B Latest Type

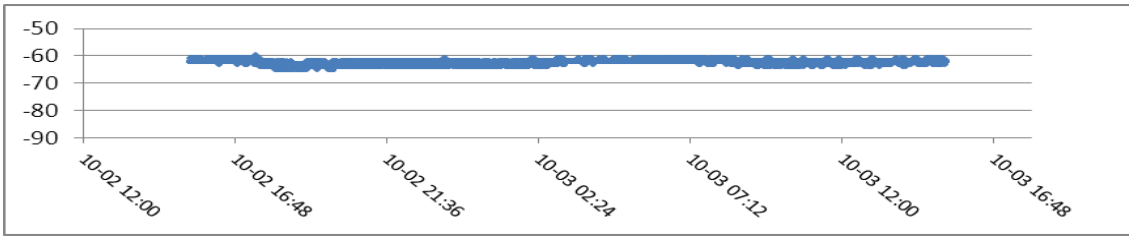


### 5.2a.6: Tidal Chart from Observatory

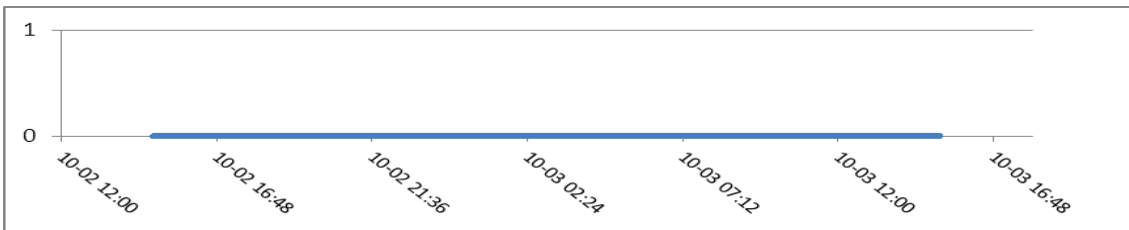


## 5.2b Plot of Point 2 – Pottinger Peak Transposer Station (PN945)

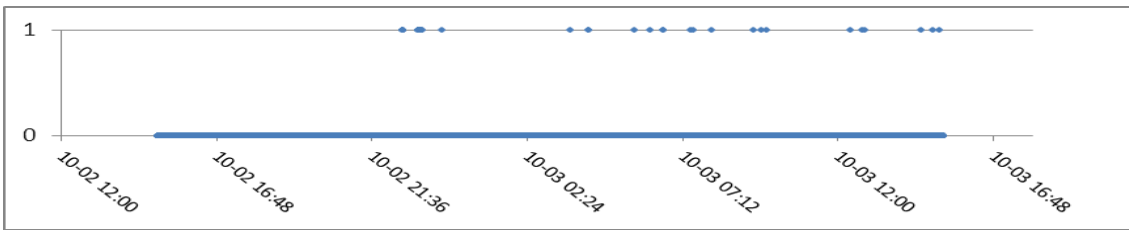
### 5.2b.1: Input Level (dBm)



### 5.2b.2: PN945 Brand A Grandfather Type



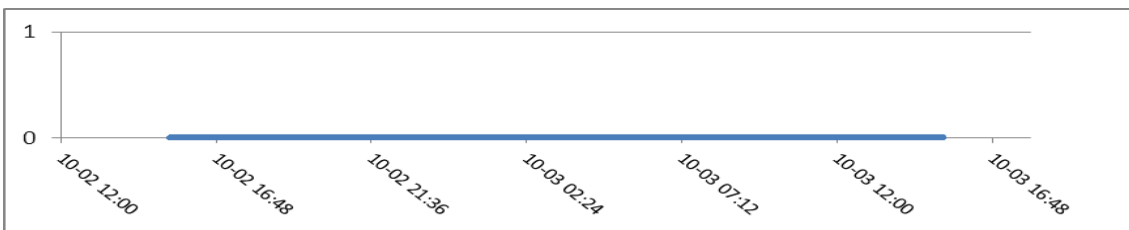
### 5.2b.3: PN945 Brand A Latest Type



### 5.2b.4: PN945 Brand B Grandfather Type

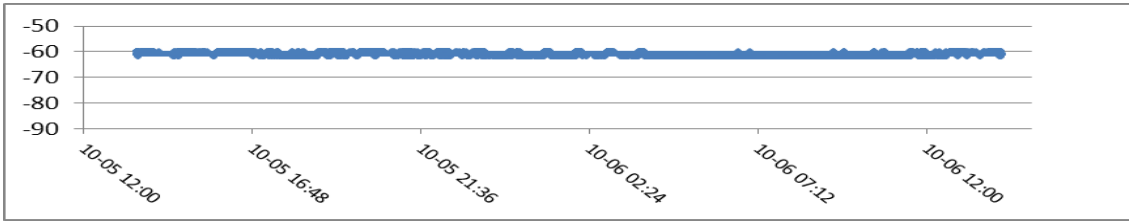
N.A.

### 5.2b.5: PN945 Brand B Latest Type

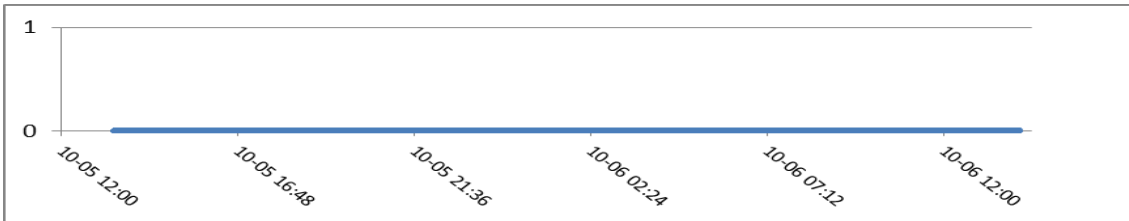


### 5.3a Plot of Point 3 – Mount Nicholson Transposer Station (PN420)

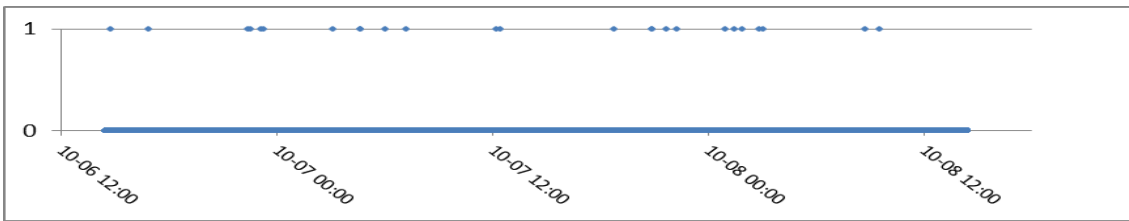
5.3a.1: Input Level (dBm)



5.3a.2: PN420 Brand A Grandfather Type



5.3a.3: PN420 Brand A Latest Type



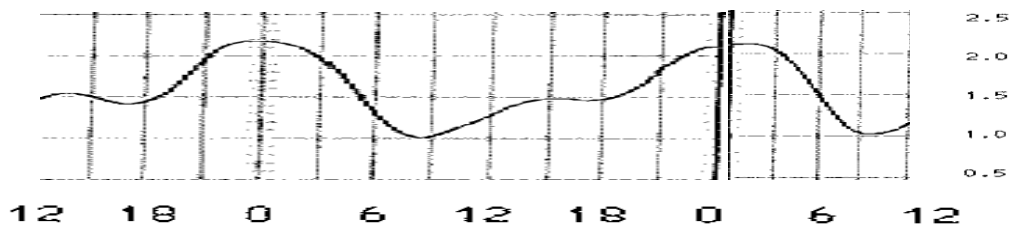
5.3a.4: PN420 Brand B Grandfather Type



5.3a.5: PN420 Brand B Latest Type

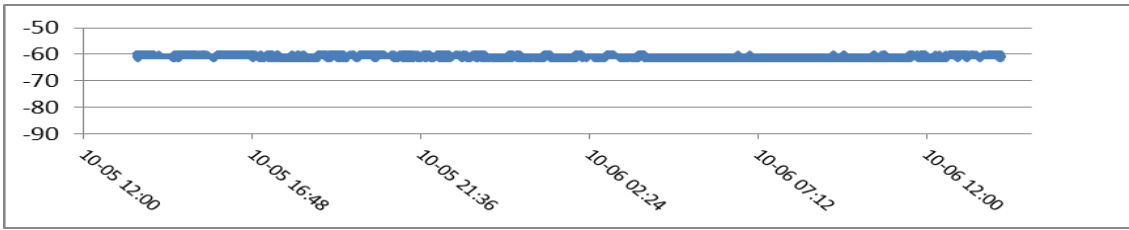


5.3a.6: Tidal Chart from Observatory

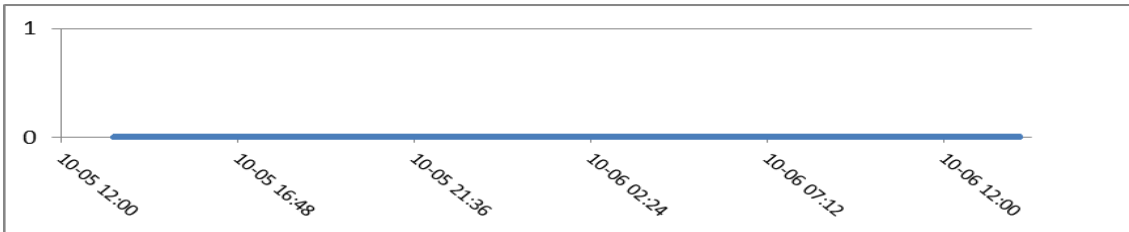


### 5.3b Plot of Point 3 – Mount Nicholson Transposer Station (PN945)

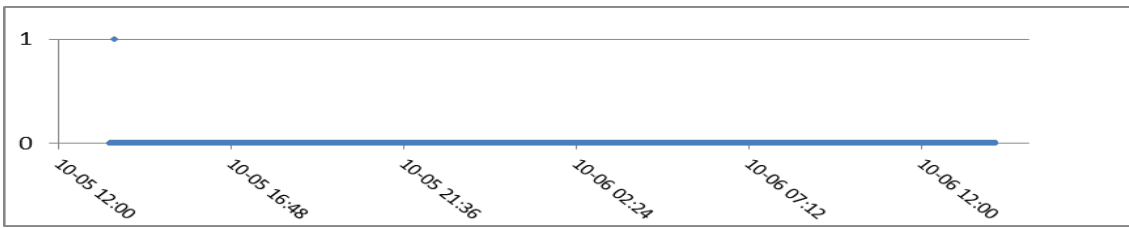
#### 5.3b.1: Input Level (dBm)



#### 5.3b.2: PN945 Brand A Grandfather Type



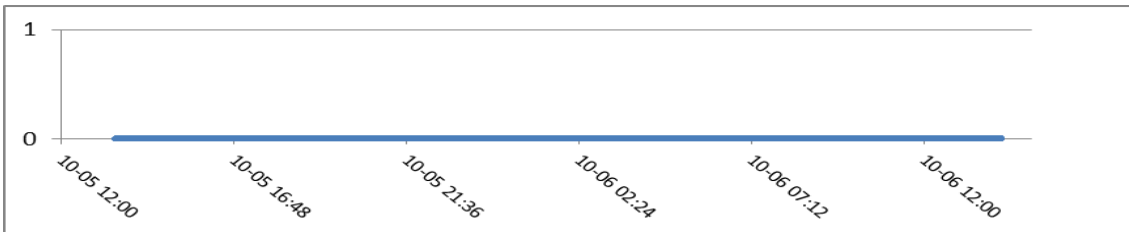
#### 5.3b.3: PN945 Brand A Latest Type



#### 5.3b.4: PN945 Brand B Grandfather Ttype

N.A.

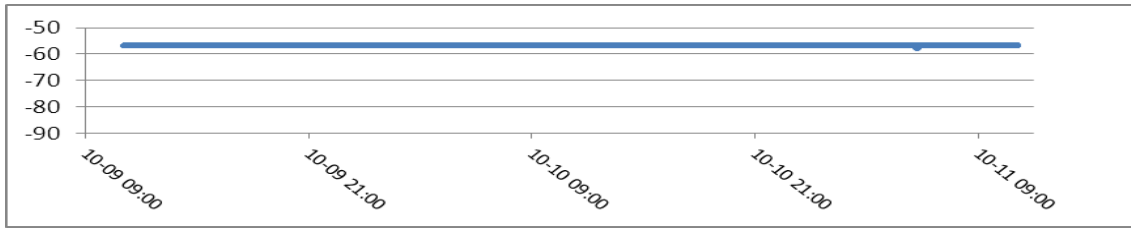
#### 5.3b.5: PN945 Brand B Latest Type



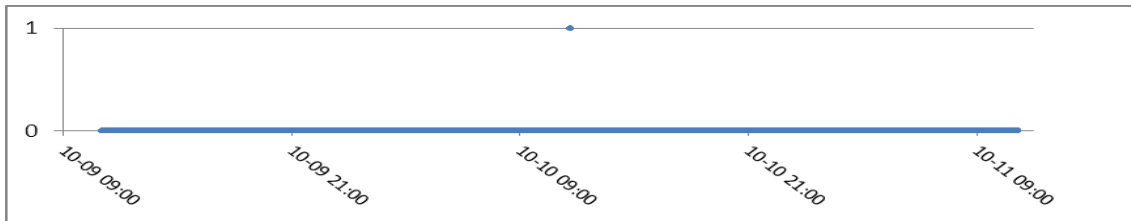


### 5.4a Plot of Point 4 – Cheung Chau Transposer Station (PN420)

5.4a.1: Input Level (dBm)



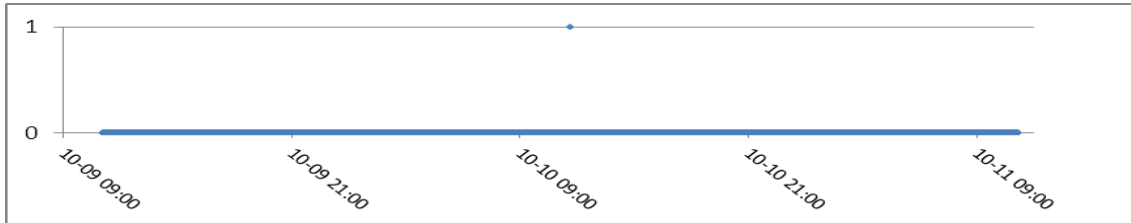
5.4a.2: PN420 Brand A Grandfather Type



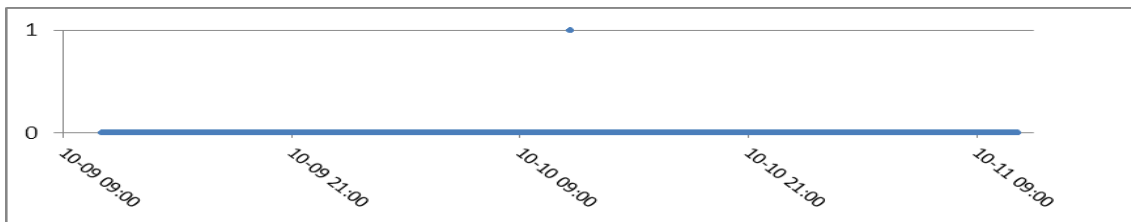
5.4a.3: PN420 Brand A Latest Type



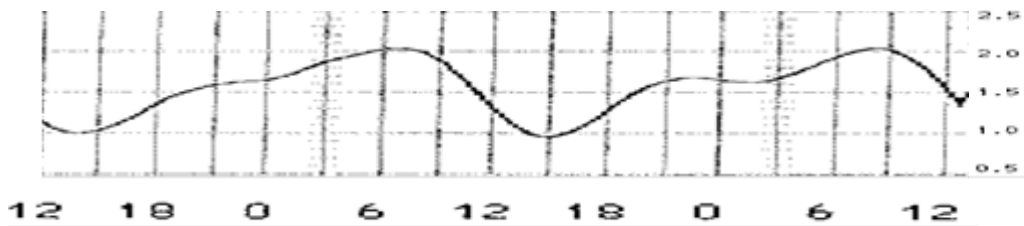
5.4a.4: PN420 Brand B Grandfather Type



5.4a.5: PN420 Brand B Latest Type

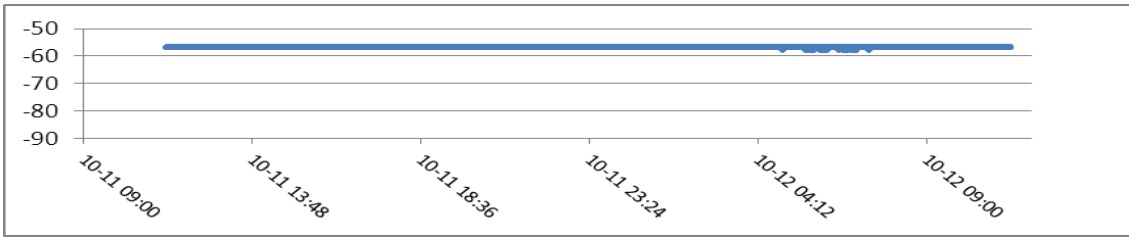


5.4a.6: Tidal Chart from Observatory

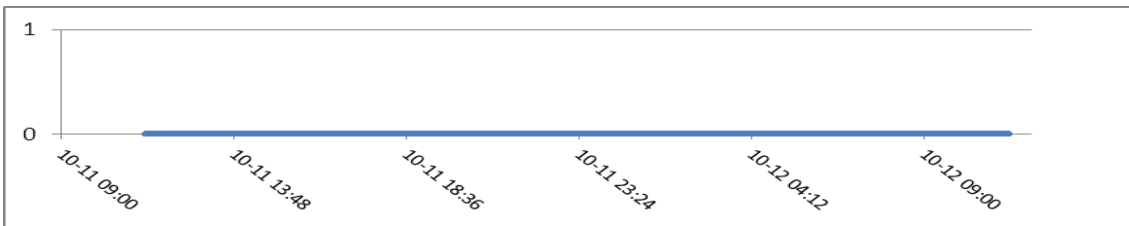


### 5.4b Plot of Point 4 – Cheung Chau Transposer Station (PN945)

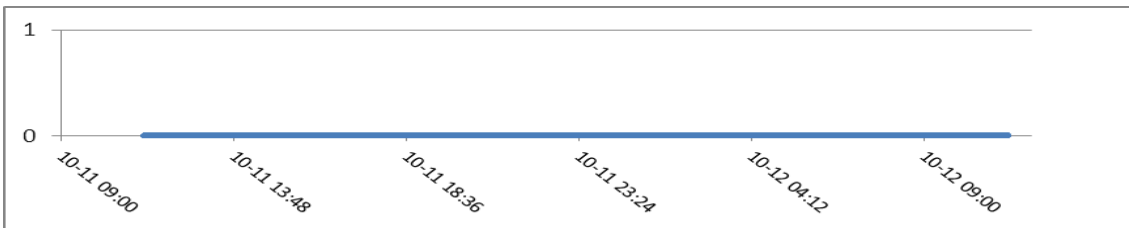
#### 5.4b.1: Input Level (dBm)



#### 5.4b.2: PN945 Brand A Grandfather Type



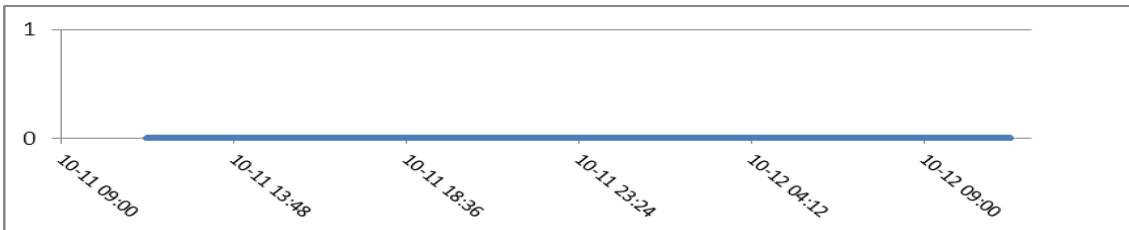
#### 5.4b.3: PN945 Brand A Latest Type



#### 5.4b.4: PN945 Brand B Grandfather Ttype

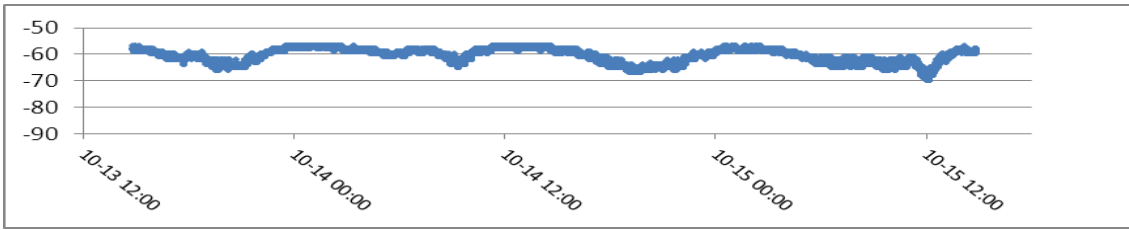
N.A.

#### 5.4b.5: PN945 Brand B Latest Type



### 5.5a Plot of Point 5 – Nam Shan Transposer Station (PN420)

5.5a.1: Input Level (dBm)



5.5a.2: PN420 Brand A Grandfather Type



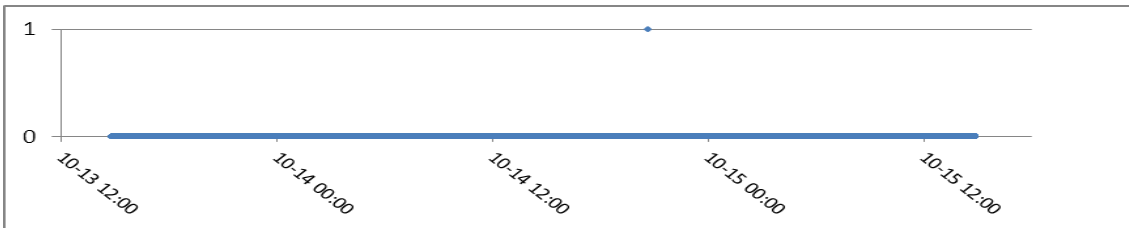
5.5a.3: PN420 Brand A Latest Type



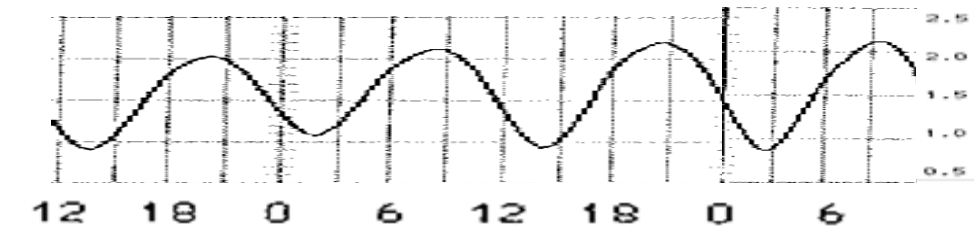
5.5a.4: PN420 Brand B Grandfather Type



5.5a.5: PN420 Brand B Latest Type

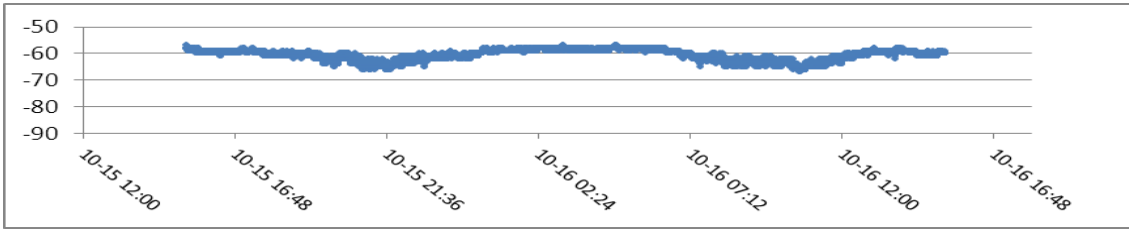


5.5a.6: Tidal Chart from Observatory

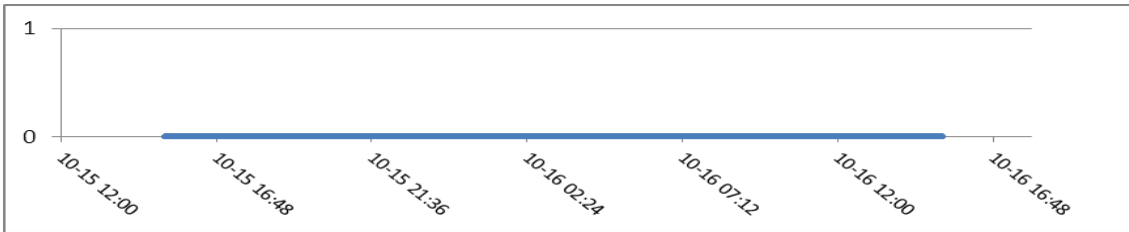


### 5.5b Plot of Point 5 – Nam Shan Transposer Station (PN945)

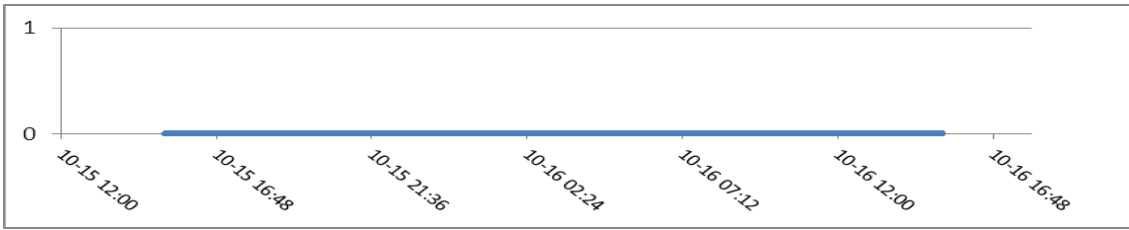
#### 5.5b.1: Input Level (dBm)



#### 5.5b.2: PN945 Brand A Grandfather Type



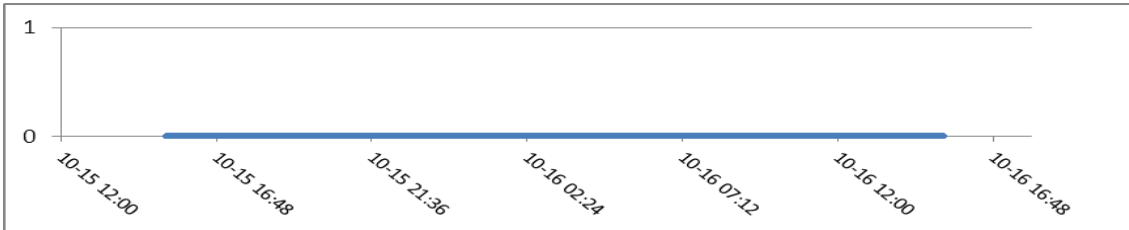
#### 5.5b.3: PN945 Brand A Latest Type



#### 5.5b.4: PN945 Brand B Grandfather Ttype

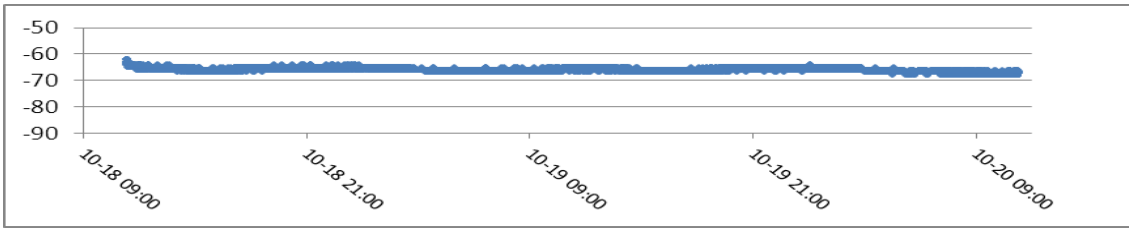
N.A.

#### 5.5b.5: PN945 Brand B Latest Type



### 5.6a Plot of Point 6 – Building Roof at Kennedy Town, Sai Ning St (PN420)

5.6a.1: Input Level (dBm)



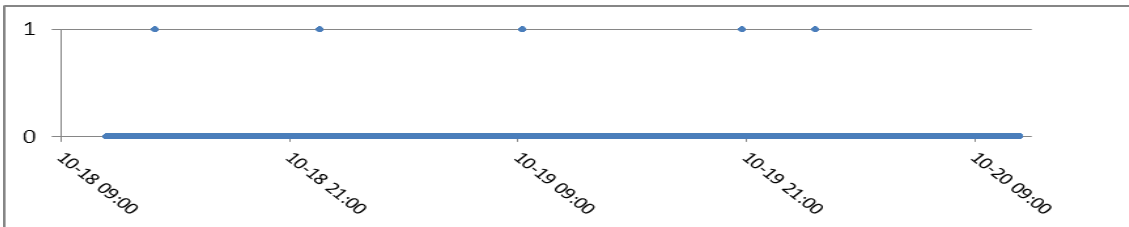
5.6a.2: PN420 Brand A Grandfather Type



5.6a.3: PN420 Brand A Latest Type



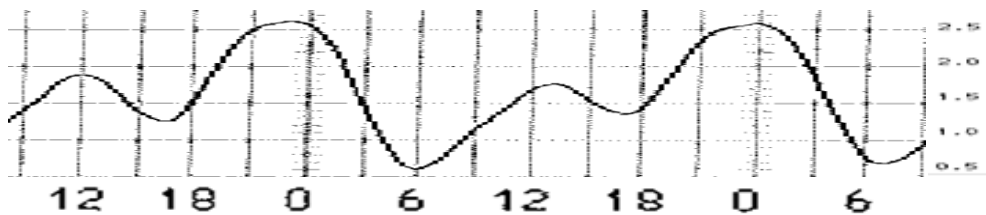
5.6a.4: PN420 Brand B Grandfather Type



5.6a.5: PN420 Brand B Latest Type

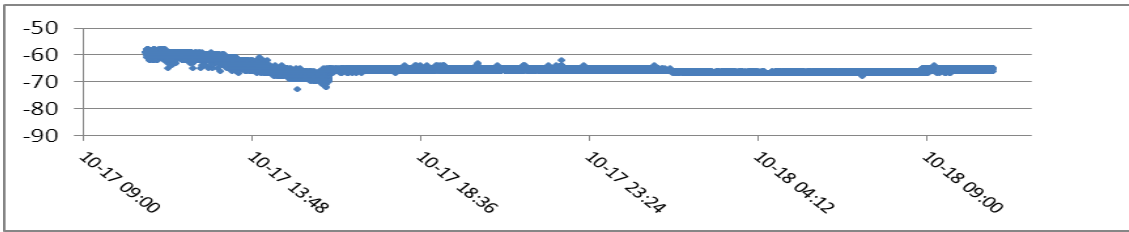


5.6a.6: Tidal Chart from Observatory



### 5.6b Plot of Point 6 – Building Roof at Kennedy Town, Sai Ning St (PN945)

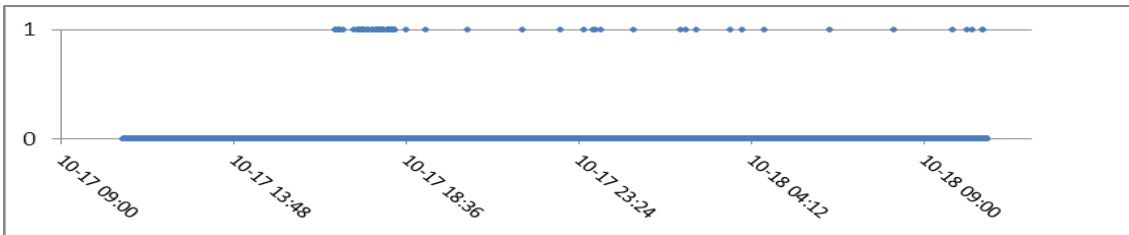
#### 5.6b.1: Input Level (dBm)



#### 5.6b.2: PN945 Brand A Grandfather Type



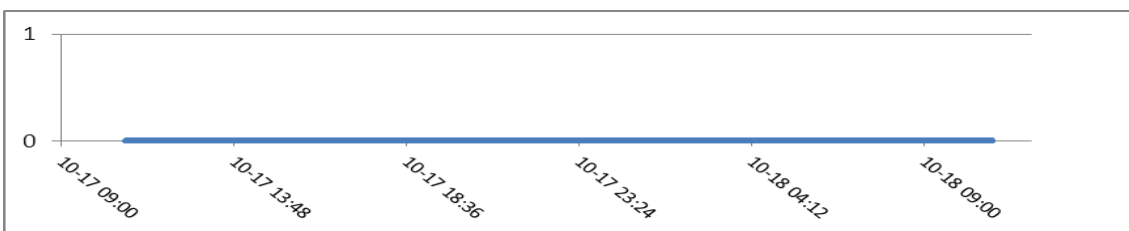
#### 5.6b.3: PN945 Brand A Latest Type



#### 5.6b.4: PN945 Brand B Grandfather Type

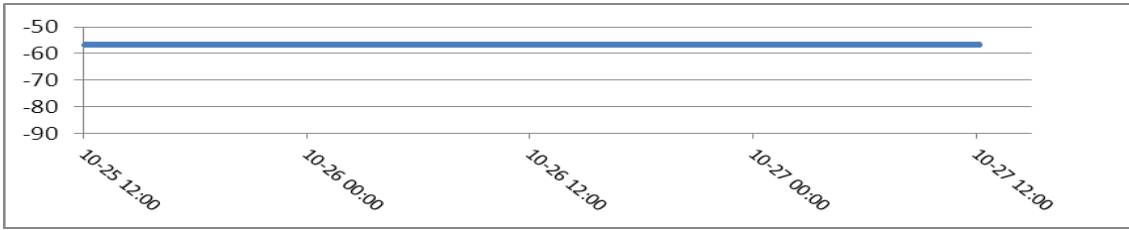
N.A.

#### 5.6b.5: PN945 Brand B Latest Type

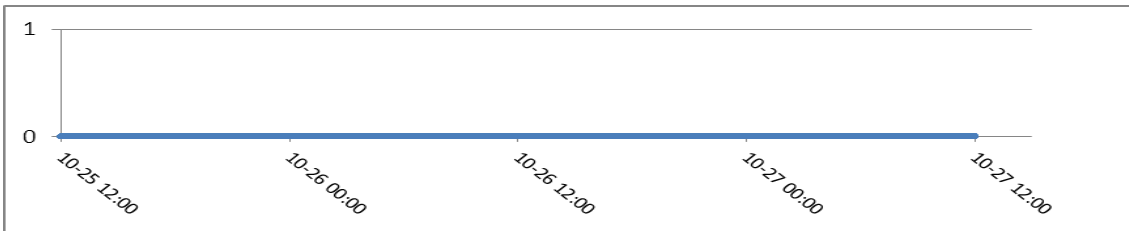


### 5.7a Plot of Point 7 – Building Roof at King’s Rd, North Point (PN420)

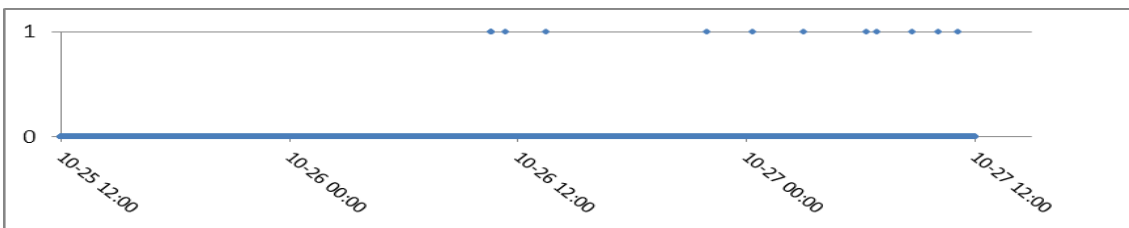
5.7a.1: Input Level (dBm)



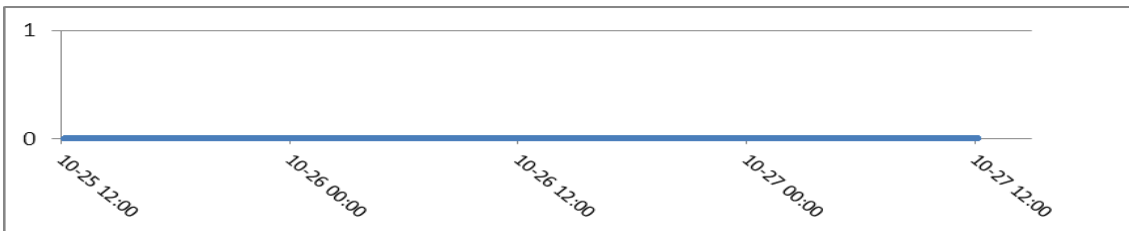
5.7a.2: PN420 Brand A Grandfather Type



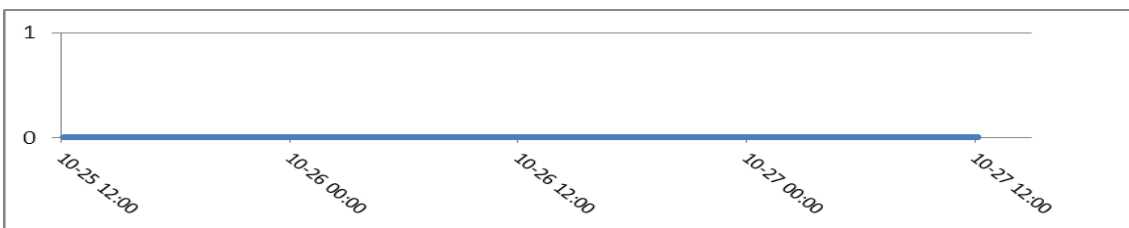
5.7a.3: PN420 Brand A Latest Type



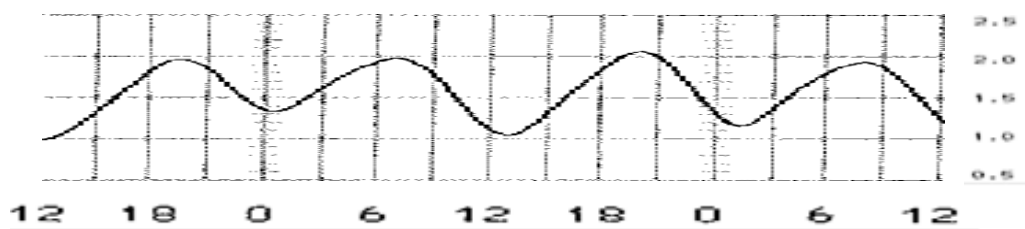
5.7a.4: PN420 Brand B Grandfather Type



5.7a.5: PN420 Brand B Latest Type

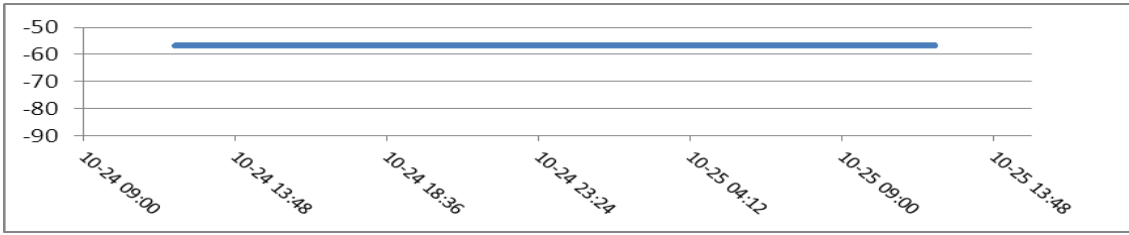


5.7a.6: Tidal Chart from Observatory

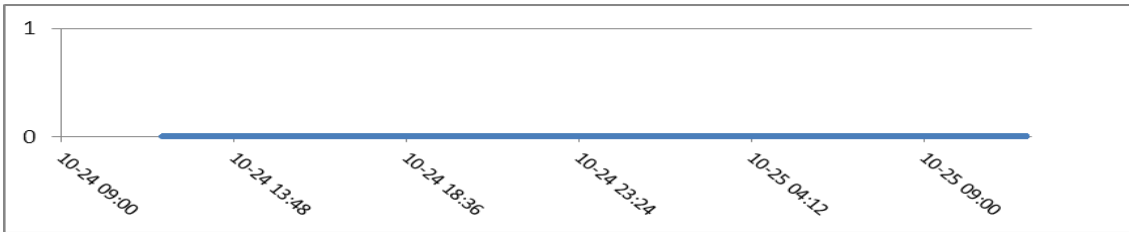


### 5.7b Plot of Point 7 – Building Roof at King’s Rd, North Point (PN945)

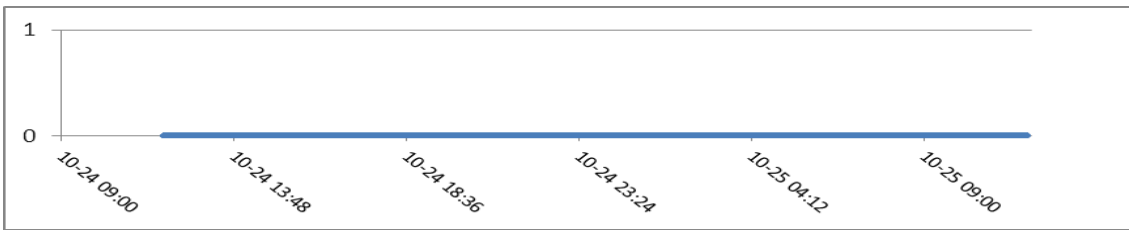
#### 5.7b.1: Input Level (dBm)



#### 5.7b.2: PN945 Brand A Grandfather Type



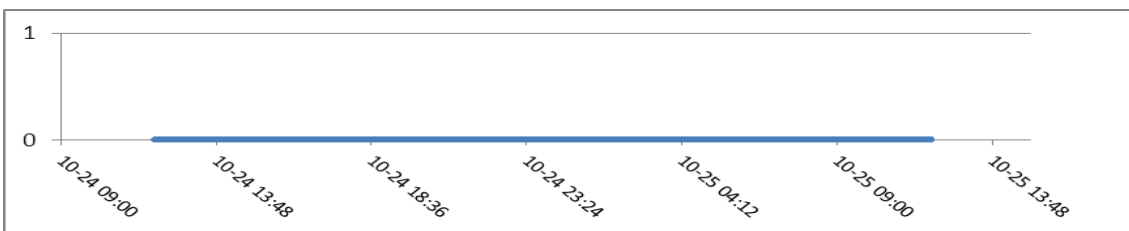
#### 5.7b.3: PN945 Brand A Latest Type



#### 5.7b.4: PN945 Brand B Grandfather Ttype

N.A.

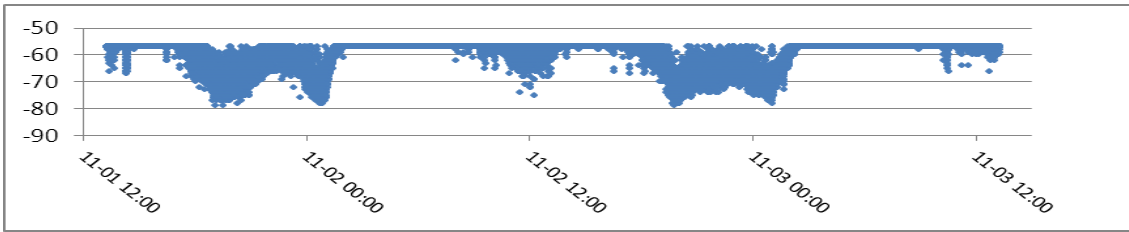
#### 5.7b.5: PN945 Brand B Latest Type



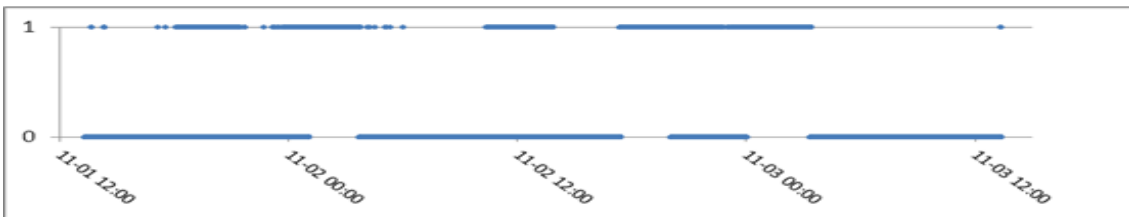


### 5.8a Plot of Point 8 – Cadogan Street, Sai Wan (near seaside) (PN420)

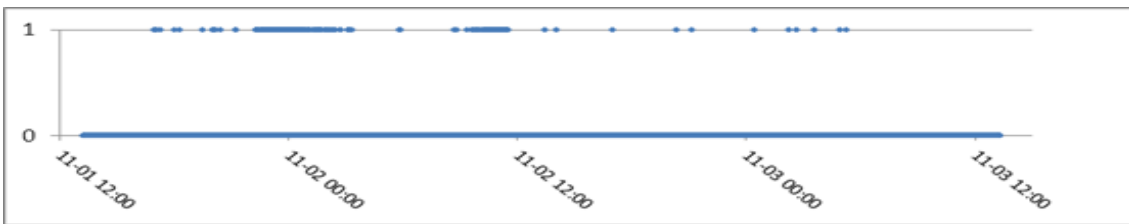
5.8a.1: Input Level (dBm)



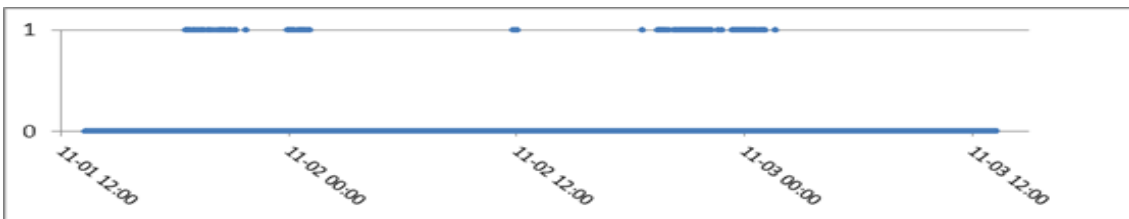
5.8a.2: PN420 Brand A Grandfather Type



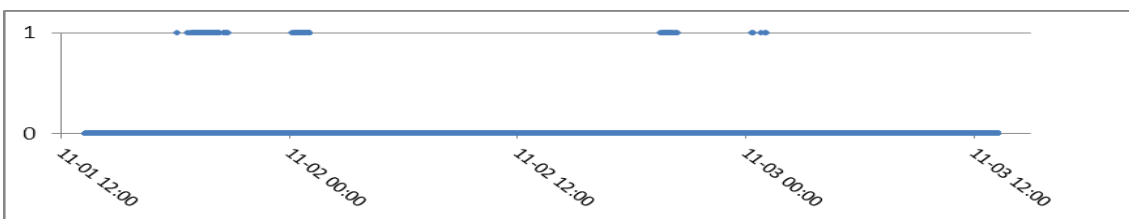
5.8a.3: PN420 Brand A Latest Type



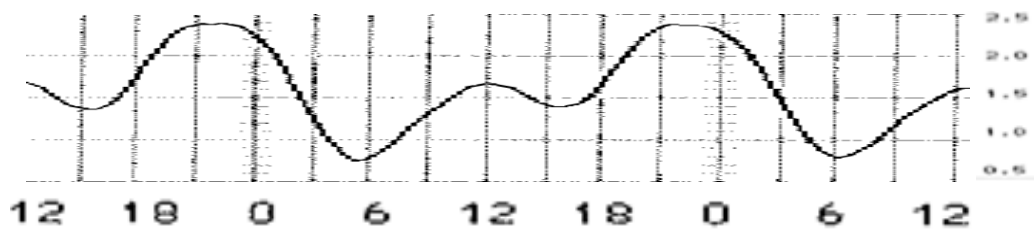
5.8a.4: PN420 Brand B Grandfather Type



5.8a.5: PN420 Brand B Latest Type

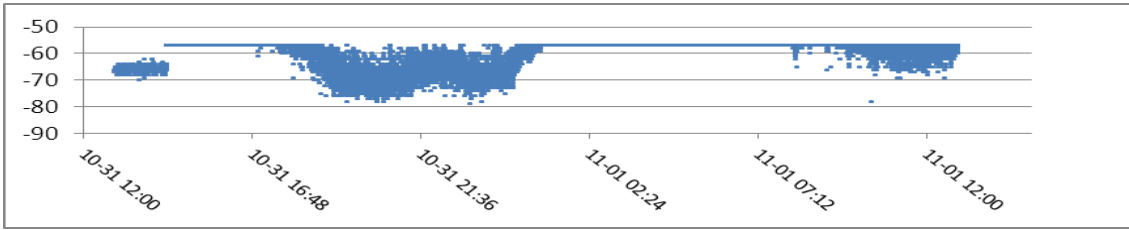


5.8a.6: Tidal Chart from Observatory

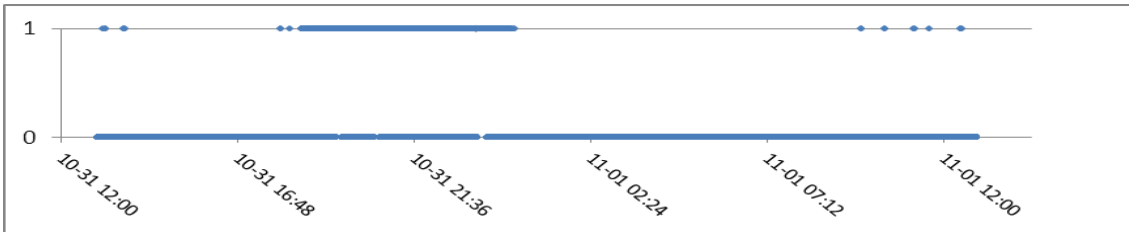


**5.8b Plot of Point 8 – Cadogan Street, Sai Wan (near seaside) (PN945)**

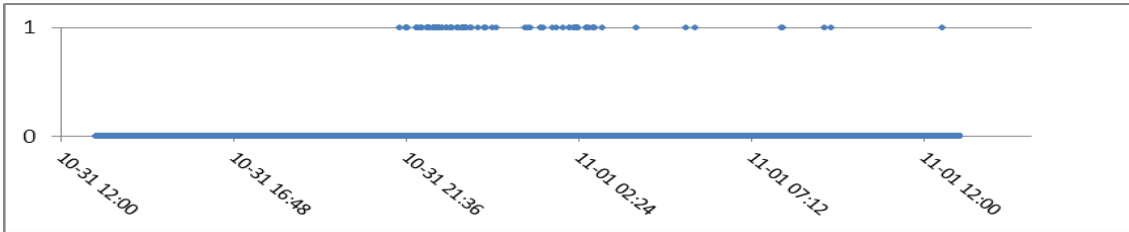
5.8b.1: Input Level (dBm)



5.8b.2: PN945 Brand A Grandfather Type



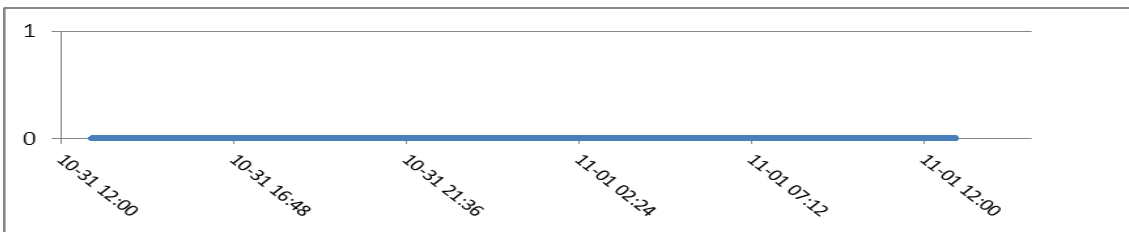
5.8b.3: PN945 Brand A Latest Type



5.8b.4: PN945 Brand B Grandfather Ttype

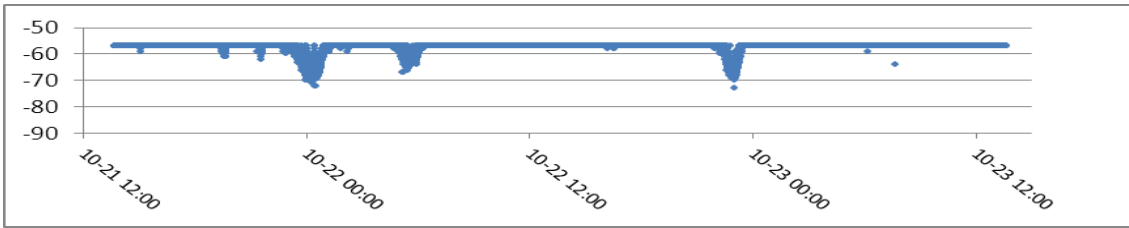
N.A.

5.8b.5: PN945 Brand B Latest Type

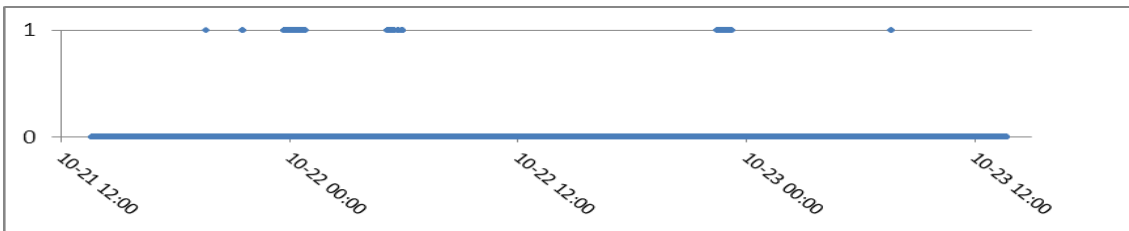


### 5.9a Plot of Point 9 – Hoi Yu Street, Quarry Bay (HKE Pole No.47718) (PN420)

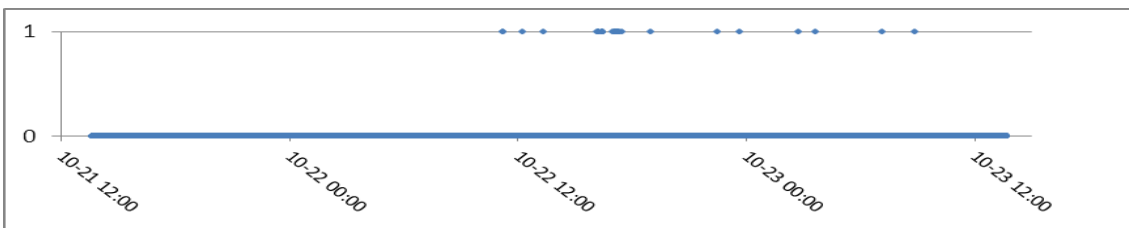
5.9a.1: Input Level (dBm)



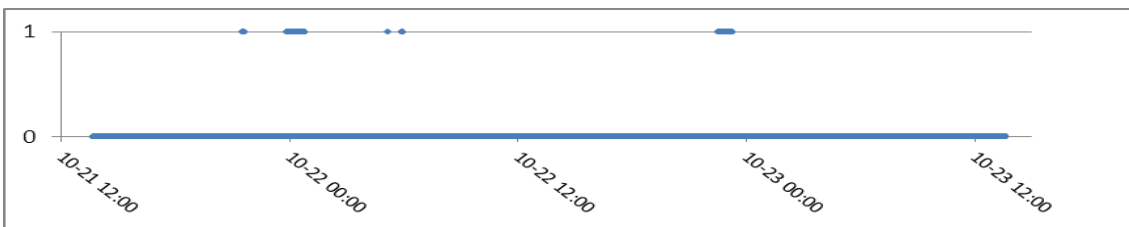
5.9a.2: PN420 Brand A Grandfather Type



5.9a.3: PN420 Brand A Latest Type



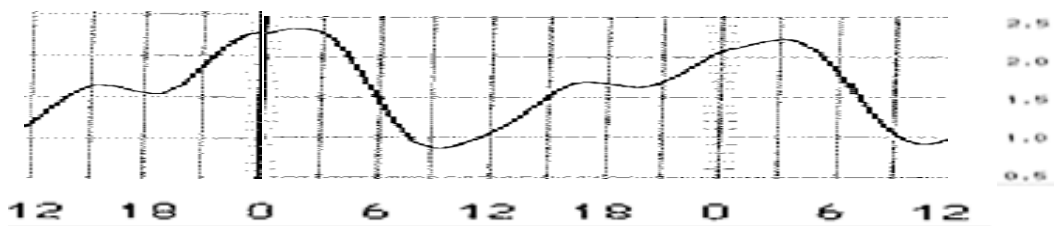
5.9a.4: PN420 Brand B Grandfather Type



5.9a.5: PN420 Brand B Latest Type

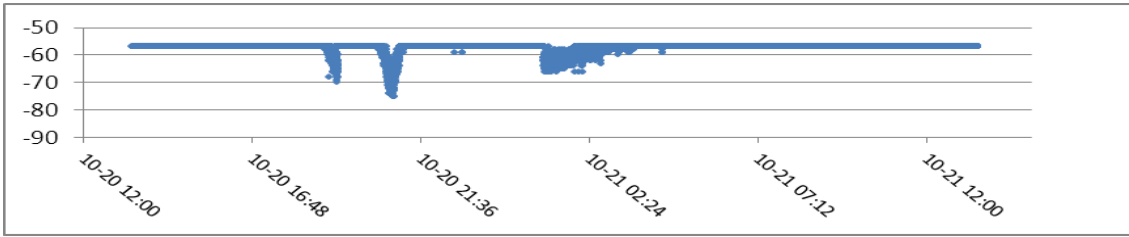


5.9a.6: Tidal Chart from Observatory

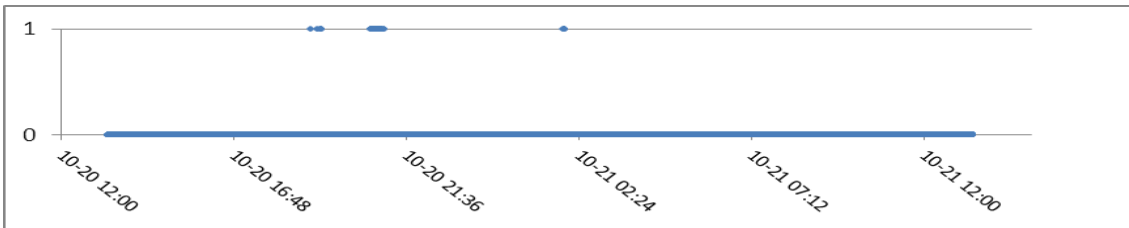


**5.9b Plot of Point 9 –Hoi Yu Street, Quarry Bay (HKE Pole No.47718) (PN945)**

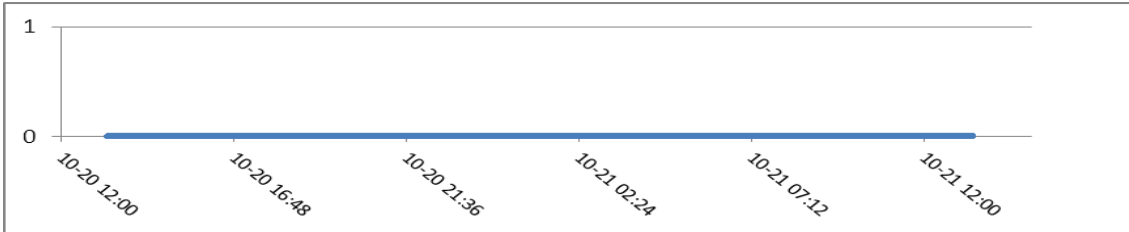
**5.9b.1: Input Level (dBm)**



**5.9b.2: PN945 Brand A Grandfather Type**



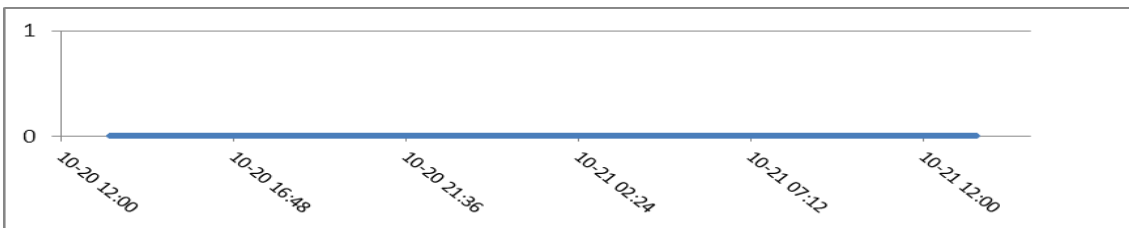
**5.9b.3: PN945 Brand A Latest Type**



**5.9b.4: PN945 Brand B Grandfather Ttype**

N.A.

**5.9b.5: PN945 Brand B Latest Type**



End of Report