



**Reception survey for  
assessment of coverage area  
for satisfactory reception of  
HPT (TV) Transmitter  
(Analogue) *Located*  
*at*  
*Fazilka (Punjab)***

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**(Survey Period: 25/05/2016 to 02/06/2016)**

# **Field Strength Measurement/Reception Survey Team**

## **PROPAGATION LAB**

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**Team Members : Chandra Ballabh (Sr. Technician)  
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**Assisted By : G P Srivastava (AE)**

**Staff Car Drivers : Ranbir (SCD)**

**Guided By : Sh. Deepak Kumar (DDG)**

**Inspired By : Mrs. Anuradha Agarwal (ADG)**

## **Introduction:**

A decade ago most of the TV transmitters in India were either valve based or semi-solid state based. Later on valve based transmitters were replaced with new solid state transmitters which are more power efficient, robust & easy to manage them. In this process one of the transmitter located at historical city Fazilka in Punjab carrying DD National Programme was replaced with new **Harris make** solid state UHF TV transmitter in December 2015. The transmitter is of **10kW** rated power. The height of self supported antenna mast is **305 meters**, the second highest in the India. In respect of the new Harris transmitter, coverage of satisfactory reception is to be predicted. This task was given to Propagation Lab unit of The Research Department. A three member survey team was constituted & deployed for carrying out field strength survey for assessment of coverage area. The survey work was carried out during the period 25/05/2016 to 02/06/2016. The scope of this field trial was to assess the primary coverage area of Harris make TV transmitter broadcasting DD National Programme. The survey was carried out with the help of 10 meter mast mounted on survey vehicle of Propagation labs.

## **Objective:**

1. Ascertaining the coverage area for satisfactory reception of Analog Transmission.
2. To envisage minimum field strength value for satisfactory reception.

## **Equipment Used:**

1. Spectrum Analyzer(Make: Anritsu, Model: MS 2035B & MS 2013E)
2. UHF Dipole antenna(Make: Anritsu, Model: MP651B)
3. GPS Navigator(Make: Garmin, Model: Montana 650)
4. LED TV Receiver(Make: Sony, )
5. Survey Van fitted with 10 Meters Mast & Portable Generator etc)

## Basic Data and Transmitter details

### **Transmitters Details:**

1. Name of Station : HPT(TV) Tower, Fazilka(PB)
2. Location of the Transmitters : LAT- N 30.39575 °  
(In 6 figure coordinates) LON- E 074.03514°  
Height above MSL-302 Meter
3. Description of terrain around the Transmitters : Urban, Moderate Traffic,
4. Classification(Large city/urban/rural) : Urban
5. Rated power of the Transmitter : 10.0kW
6. Forward radiated Power : 9.90kW
7. Reflected Power : 100 WATTS
8. VSWR : 1.10
9. Transmission Mode : Analogue(PAL)
10. Make : Harris
11. Model No. : ULX-100000AN-Maxiva
12. Frequency of operation : Vision:471.25MHz (CH#21)
13. Date of Commissioning : December-2015

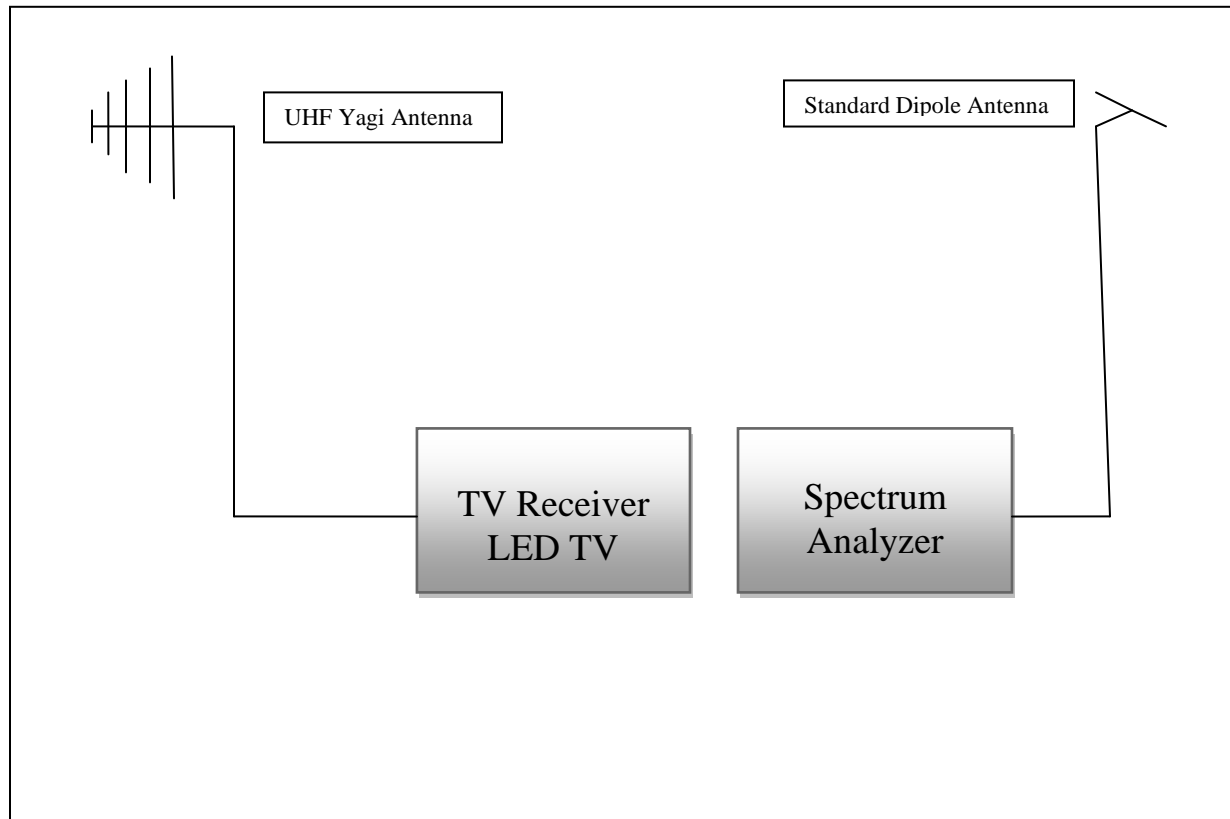
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### **Transmitting Antenna Details:**

1. Make : ALDENA
2. Type /Model of Antenna :
3. Antenna Gain : NA
4. Height of Tower : 302 Meter
5. Effective height of antenna(Midbay) : Not available
6. Type of Polarization : Horizontal
7. Tower : SS

## System configuration:

The field trials system mainly consists of field strength measuring equipment, standard calibrated UHF Dipole antenna & Yagi receiving antenna for receiving horizontally polarized TV Broadcast signal, Portable Generator, 10 Meters electromechanically operated telescopic mast housed in a customized Survey Van of Research Department. A pictorial diagram is given below.



## Measurement Set Up:

The field trials were carried out by utilizing mobile survey van of Research Department having 10 meter pneumatic telescopic mast. Field strength measurement was carried out, using Anritsu make Spectrum Analyzer & UHF Dipole Antenna. The whole system was assembled in a mobile van with power generating system (portable generator set). The two main components of the reception set up are analogue TV receiving system and field strength measuring system (Spectrum Analyzer). A calibrated UHF dipole antenna is used to receive the signal whereas for subjective assessment of the received signal was performed by using Sony makes LED TV. In addition to this Garmin make GPS navigator was used for determination of the spot/location coordinates & radial distance (LOS) from the transmitter location.

## **Selection of sites for measurement:**

As far as practicable an open & safe spot/ location (overhead power and telephone cables, trees and other hazards were avoided) was chosen for the measurement of received field strength. Instead of cluster measurement (measurement at four to five spot for a given location), single sample method in this survey is preferred, because of the additional time that may be taken in making cluster measurements (due to the frequent raising or lowering of the receiving antenna & insufficient space along the motorable road side), or because of the hazards in moving the measuring vehicle while the antenna is fully erected. High tension overhead wires, close to high rise buildings & elevated flyovers/underpasses were avoided while collecting field strength data along a radial route.

## **Measurement Methodology:**

A map was used to mark the location of the transmitters. From the transmitter location only four instead of eight radials were drawn passing through the transmitter location along North-East, East, South-East, South, West up to the distance of 14 Km (LOS). Rest all radial directions lies in the Pakistan. For prediction of the coverage area, field strength measurement along a radial is carried out by employing mobile survey van having 10Mtrs telescopic mast with rotor & tilt facility. For field strength measurement the survey vehicle was mostly parked in open space, raising the telescopic mast up to the required height of 10 meters & then rotating the antenna to align it along the direction of transmission source for getting optimum value of field strength. While taking static reception measurement LAT/LONG, MSL & radial distance of each & every location was also recorded. Once all measurements have been undertaken, mast is fully retracted & then driven away for the next location. Since the purpose of the survey was to determine the primary coverage area for satisfactory reception so the measurement was carried out in static condition along motorable roads. The same procedures for field strength measurement/reception survey are adopted along all other four radials. After data collection is over the FSM data are tabulated & interpreted on the basis of the findings. The quality of received audio/video was also analyzed by using SONY make receiver under given terrain conditions. The environment classification criteria are:

<b>Rural</b>	Areas with scarce isolated buildings, open fields.
<b>Suburban</b>	Small towns; residential areas with low building density and buildings not higher than two stories; wide roads or streets between buildings.
<b>Urban</b>	Big to medium sized cities, residential areas with high density of buildings; areas where buildings are higher than two stories and close distances between them
<b>Large Cities</b>	Densely populated cities having cluster of township with high rise building & skyscrapers

## **TV Broadcast Signal Propagation:**

TV broadcast signal propagates from the transmitter by space wave propagation mechanisms i.e. Line of sight Propagation & travel straight way in propagating medium & undergoes all optical phenomena like Reflection, Refraction, Scattering, Diffraction etc while travelling through the medium. It is also important to point out other factors typical of urban reception environment such as traffic, speed change due to traffic lights and pedestrian crossings, etc. The field strength level, at a given point, not only depends on its distance from the transmitter, the frequency of transmission and the antenna heights but also on the long-term and short-term interferences caused by reflections of the natural environment (terrain configuration, vegetation) and the man-made environment. Thus the received signal must be considered as the vector sum of the wanted signal and many reflected signals. Due to the effect of reflected signals, the Field Strength along a route shows severe fluctuation. Since, the measurements are made on public roads the reflected signals coming from other vehicles cannot be foreseen. The field strength test results therefore very rarely match the results of measurements obtained at the same place, at a different time.

## **Collection of field strength data:**

The field strength data were collected along five radials routes around the transmitting antenna. At each & every spot/location along the radial the telescopic mast was expanded upto 10 Meters from the ground level keeping the dipole antenna horizontally as the polarization of the radiated beam is horizontally polarized. The antenna position is being continuously rotated for optimized value of field strength in the direction of line of sight with respect to the transmitting antenna. The optimum field strength values are thus recorded. In addition to this the terrain detail of each & every spot/location was also recorded along with the subjective assessment of the received audio/video quality on the basis of watching on TV receiving system These collected data's are being tabulated in proper sequence to make it convenient for discussion & correlation with other parameters. The subjective assessment of received audio/video quality on TV receiver is graded as E (Excellent), VG (Very Good), G (Good), F (Fair) & P (Poor). The field strength measurement values along with subjective assessment at each & every spot/location are recorded in a tabular form giving at an instance the trend for variation in received field strength & signal reception quality with distance. In this report the received field strength & subjective assessment data collected along eight radials are tabulated accordingly in Table No.-1 to Table No.-5. In addition to this the radial distances & field strength value corresponding to satisfactory reception along all four radials are compiled in tabular form (as in Table No: 6) to make it convenient to determine the primary coverage area of the said transmission. On the basis of Table-6, a coverage contour for analogue TV transmission has been drawn & annexed as in Annexure-I & II. The code used for grading of the received signal is illustrated as follows.



### Criteria for grading of received signal on the basis of subjective assessment:

<b>Signal</b>	E	Excellent	No impairment in received audio/video quality.
	VG	Very Good	Near to excellent with antenna direction
	G	Good	Light grains on screen but irritable of nature
	F	Fair	Moderate grains on TV screen but tolerable
	P	Poor	Huge grains causing irritation & intolerable

### Broadcast Service Area:

The objective of broadcasting is to provide quality reception, free from interferences & noise in a commercial domestic receiver, either fixed or mobile, to as much of population and area of the country as possible, In case of analogue transmission coverage area of broadcasting is decided by the minimum required received ‘field strength’ at the farthest end of the coverage area for satisfactory reception with commercially available domestic receivers. As per recommendation of ITU, minimum equivalent field strength value at 10Meters height for satisfactory reception of VHF/UHF transmission are as illustrated in following table.

<b>Broadcast Band</b>		<b>Frequency</b>	<b>Minimum Field Strength</b>			
VHF	Band-I	40-68 MHz	48 dB $\mu$ V/M			
	Band-II (Exclusively used for FM Radio Services)	88-108 MHz	Transmission Mode	Large Cities	Urban	Rural
			Mono	70 dB $\mu$ V/M	60 dB $\mu$ V/M	48 dB $\mu$ V/M
	Stereo	74 dB $\mu$ V/M	66 dB $\mu$ V/M	54 dB $\mu$ V/M		
Band-III	174-230 MHz	55 dB $\mu$ V/M				
UHF	Band-IV	470-606 MHz	<b>65 dB<math>\mu</math>V/M</b>			
	Band-V	606-798 MHz	70 dB $\mu$ V/M			

## **Interpretation of the collected data along radials:**

In this report efforts are being made for the interpretation & analysis of the collected FSM data along a radial & then a coverage contour based on compiled Table-6 for satisfactory reception of Analog transmission was drawn on a map.

1. **Radial-1(East)**: Along this radial field strength measurement done at location like Ghattanwali, Mandi Rorawali & Muktsar sahib up to a radial distance of 60 kM. Satisfactory(F/S) reception of HPT(TV) Transmission was observed to be up to a radial distance of 40kM.
2. **Radial-2 (South-East)**: Along this radial field strength measurement done at location like Malout Road, Abohar Sito Road, up to a radial distance of 50 kM . Satisfactory reception of HPT(TV)Transmission was observed to be up to a radial distance of 45 kM
3. **Radial-3(South)**: Along this radial field strength measurement done at location like National Highway Abohar, Abohar and towards Sri Ganganagar up to a radial distance of 65 kM . Satisfactory reception of HPT (TV) Transmission was observed to be up to a radial distance of 65 **Km**.
4. **Radial-4(North-East)**: Along this radial field strength measurement done at location like Jalalabad, Ferozpur up to a radial distance of 70 kM. Satisfactory reception of HPT(TV) Transmission was observed to be up to a radial distance of 60kM.
5. **Radial-5(East & North-East)**: Along this radial field strength measurement done at locations like Ferozpur Muktsar Road & Malout Fazilka Road up to a radial distance of 70 kM . Satisfactory reception of HPT (TV) Transmission was observed to be up to a radial distance of 35kM.

## **Conclusion:**

On the basis of received field strength values & subjective assessment of the video quality at various spot/location along five radials & coverage contour(Annexure-I &II) drawn on the basis of table prepared/compiled for satisfactory reception of analogue TV transmission following conclusions can be stipulated.

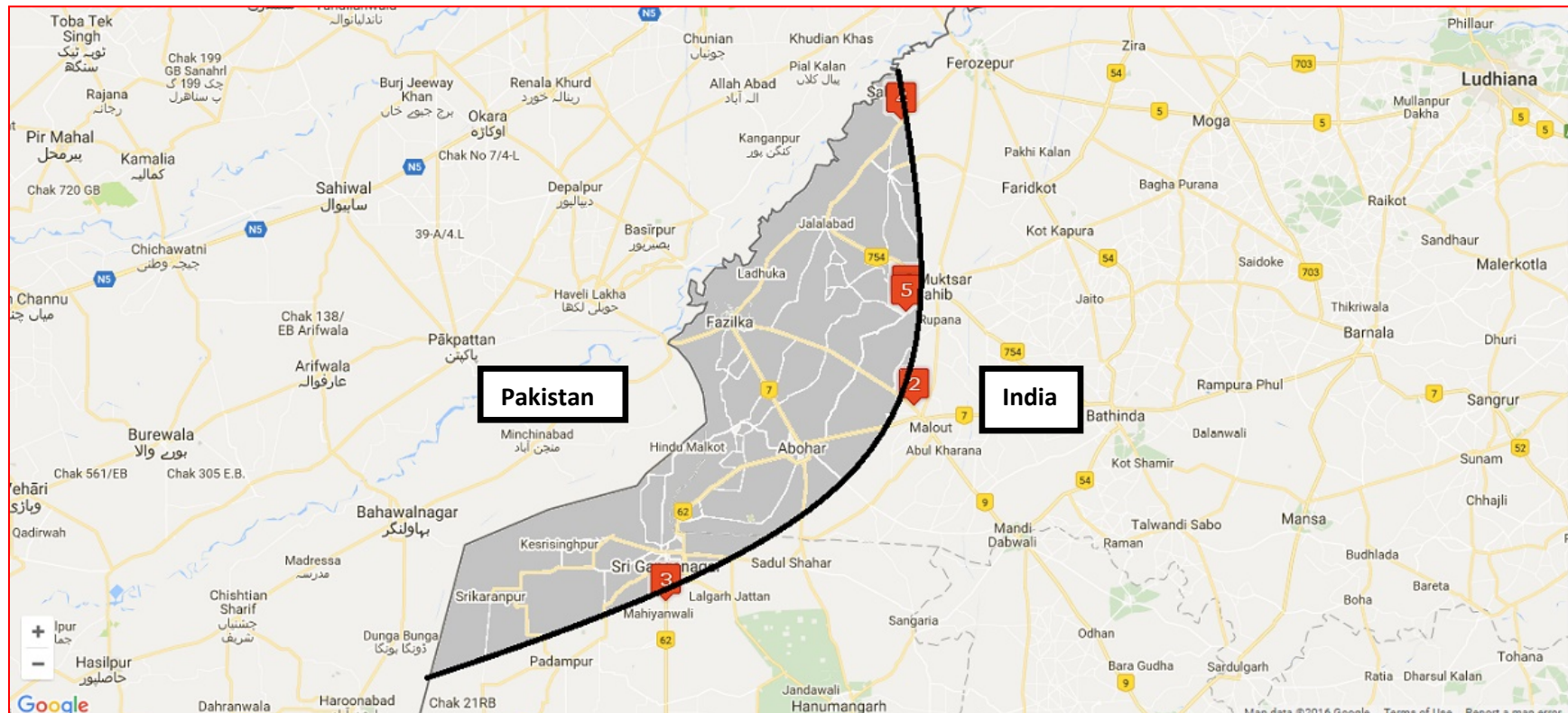
1. The coverage observed was 40 km in the East direction with respect to minimum field strength in UHF band i.e., 65db $\mu$ v/m.
2. In the South-East direction it was 45 Km.
3. In the South direction towards Abohar & Sri Ganganagar , it was 65 Km.

4. In the north-East direction the coverage was up to 60 km.
5. In the direction of East & North East it was up to 35 Km.
6. Predicted coverage contour (Annexure-II) reveals that reception is satisfactory within the predicted coverage area (up to 35-65 km) all around HPT (TV) Tower Fazilka with fixed roof top antenna mounted at a height of 10Mtrs from the ground.
7. No interference of unwanted signal in reception of analogue transmission has been observed within its coverage area.
8. More than three routes of the survey lies in the Pakistan as such prediction of those areas could not be made. **However the field strength in the West direction near Sulemanqi International border was 97db $\mu$ v/m (at the L.O.S distance of 14.36 Km) which is much more than in any other direction.** It can be presumed that coverage of Fazilka TV Transmitter towards Pakistan is better than other routes.

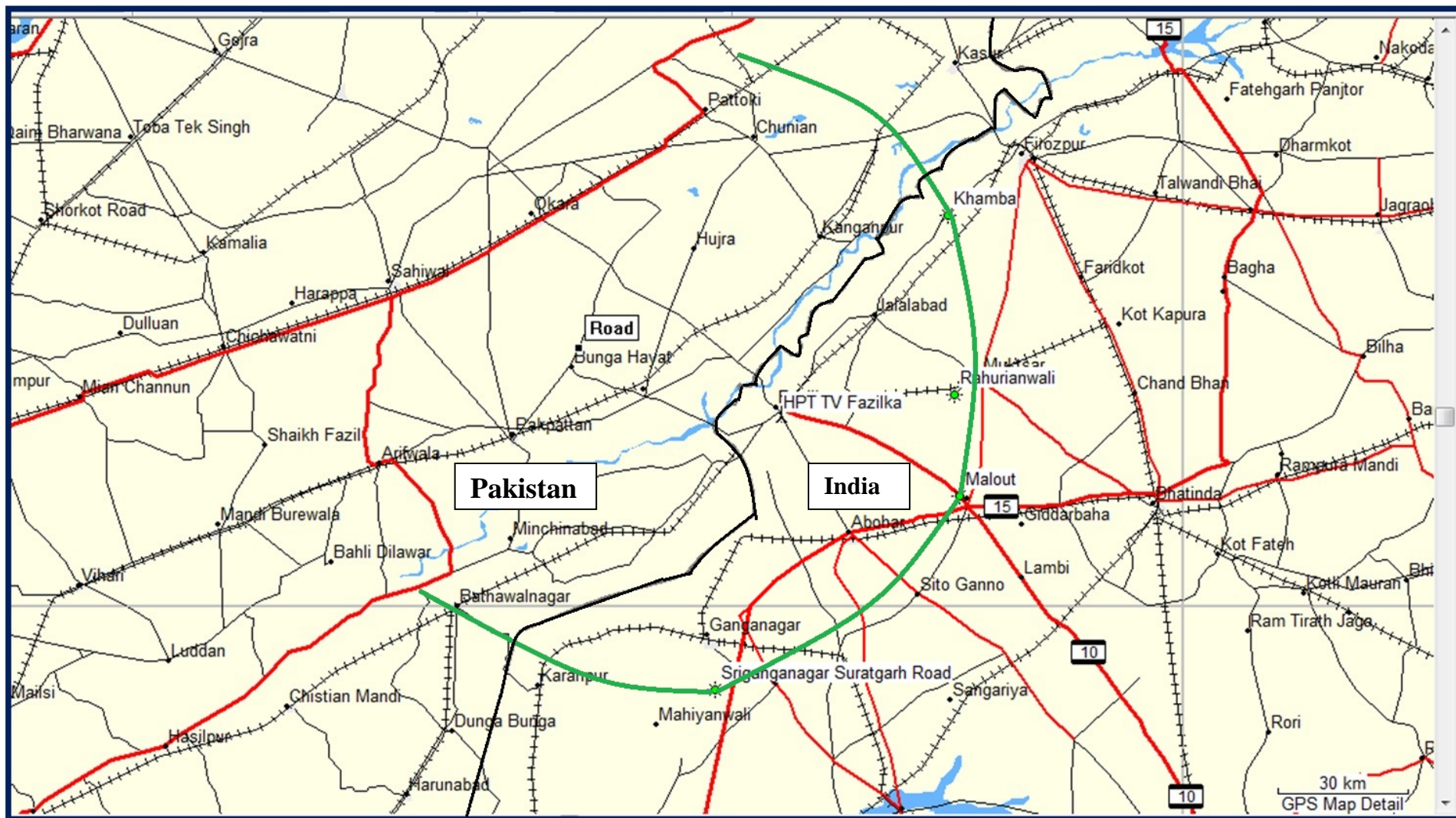
### **Acknowledgement:**

The propagation studies presented in this document are carried out by the Propagation Lab of Research Department of All India Radio & Doordarshan, New Delhi. The field trial was successfully done & the entire team acknowledges the sincere support, contribution & cooperation of the shift duty staff of HPT (TV) Tower, Fazilka (PB). Survey team also extends their gratitude to Sh. Permanand (AE) who has extended all possible help to the survey team of research department. The survey team expresses their deepest sense of gratitude to Mrs. Anuradha Agarwal (ADG) & Sh. Deepak Kumar (DDG) whose enthusiastic supervision, motivation, suggestion & cooperation at every step helped in the successful completion of the survey.

## Coverage Map of HPT (TV), Fazilka



The grey area represents the coverage of HPT (TV), Fazilka



Coverage Contour Map of HPT (TV) Transmitter Located at Fazilka (Punjab)

# Reception survey for satisfactory coverage of HPT (TV) Transmitter (471.25MHz), Fazilka (Pb)

Direction: East (Radial-1)

Table-1

Route: Tower (Fazilka) – Muktsar Sahib onwards

Date: 27/05/2016

(Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBuV/m)	Subjective Assessment	Terrain	Remarks
1020	Ghattianwali	39.39853 N 74.20537 E	171	16.35	79	E	Village / Open Area	
1042	Mandi Rorawali	30.43299 N 74.23961 E	175	20	80	E	Village / Open Area	
1117	Lakhewali	N30.44521 E74.34364	183	30	64	E	Rural/Vegetation, V Low Traffic.	
1142	Rahurianwali	N 30.44010 E 74.44918	-	40	63	E	Rural / Vegetation	
1210	Muktsar Sahib opp. Bus stand	N 30.46321 E 74.51855	192	47	56	G	Traffic/ City area	
1235	KotkapuraRoad	N 30.48610 E 74.55112	194	50	50	Poor	City outskirts / LR/ Low Traffic.	
1250	--do--	N 30.51414 E 74.64900	197	60	48	Poor	Rural, Vegetation, Low Traffic. ,	

# Reception survey for satisfactory coverage of HPT (TV) Transmitter (471.250MHz), Fazilka (Pb)

Direction: South-East (Radial-2)

Table-2

Route: TV Tower (Fazilka) – Malout-Abohar

Date: 28/05/2016

(Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBuV/m)	Subjective Assessment	Terrain	Remarks
1230	Malout Road	N 30.30746 E 74.33273	186	30	66	E	Village / Open Area	
1443	Abohar Sito Road	N 30.12603 E 74.42685	182	35	58	Fair	Village / Open Area	
1248	Malout Road	N30.25482 E74.42685	188	40	55	Poor	Rural/Vegetation, Low Traffic.	
1500	Abohar Sito Road	N 30.09830 E 74.26926	183	40	55	Poor	Rural / Vegetation	
1314	Malout road	N 30.22896 E 74.46452	190	45	63	G	Open area	
1431	Abohar Sito Road	N 30.06952 E 74.30672	182	45	62	G	Open Area	
1421	--do--	N 30.04471 E 74.33900	183	49	55	Fair	Rural /Vegetation, Low Traffic.	
1327	Malout Town	N 30.18842 E 74.50021	192	50	44	V Poor	Town Market	

# Reception survey for satisfactory coverage of HPT (TV) Transmitter (471.25MHz), Fazilka (Pb)

Direction: South (Radial-3)

Table-3

Route: Tower (Fazilka) – Abohar-Sri Ganganagar

Date: 25/05/2016

(Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dB $\mu$ V/m)10 meter	Subjective Assessment	Terrain	Remarks
1250	NH Abohar	N 30.35423 E 74.06039	176	5	94	E	Village / Open Area/Traffic	
1440	NH Abohar	N 30.31661 E 74.08518	172	10	92	E	Village / Open Area/Traffic	
1452	NH Fazilka Abohar	N30.23797 E74.13644	177	20	76	E	Rural/Vegetation / Traffic.	
1512	---do---	N 30.17540 E 74.17960	182	30	66	E	Rural / Vegetation/Traffic	
1715	Abohar-Sri Ganganagar Rd,	N 30.07944 E 74.01166	171	35	70	E	Traffic/ Vegetation	
1745	Abohar-Sri Ganganagar	N 30.00380 E 74.90494	161	45	67	E	Vegetation/ Traffic	
1814	Sri Ganganagar City, Shiv Chowk.	N 29.91930 E 73.87521	163	55	54	Fair	City/ Vegetation/Traffic	
1856	Sri Ganganagar – Suratgarh Rd.	N 29.82716 E 73.87543	166	65	65	Good	Highway/Open area/Traffic	



# Reception survey for satisfactory coverage of HPT (TV) Transmitter (471.250MHz), Fazilka (Pb)

Direction: North-East (Radial-4)

Table-4

Route: Tower (Fazilka) – Ferozpur

Date: 26/05/2016

(Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBuV/m)	Subjective Assessment	Terrain	Remarks
0945	Ferozpur Highway	N 30.44006 E 74.06294	178	5.3	109	E	Village / Open Area/Traffic	
1000	---do---	N 30.47542 E 74.09621	174	10	92	E	Village / Open Area/traffic	
1020	---do---	N30.55524 E74.14142	173	20	89	E	Rural/Vegetation, / Traffic.	
1047	Outskirts of Jalalabad	N 30.60577 E 74.23325	176	30	67	E	Rural / traffic	
1115	Jalalabad Town	N 30.60236 E 74.25555	182	31.1	73	E	Traffic/ City area	
1140	Fazilka- Firozpur Rd.	N 30.67525 E 74.30471	177	40	71	E	City outskirts / LR/ Traffic.	
1150	--do--	N 30.70786 E 74.33424	178	45	69	E	Rural /Open Area Traffic./	
1215	--do--	N 30.81270 E 74.43575	181	60	65	G	Open Area/ low Traffic	
1225	--do--	N 30.84617 E 74.47272	184	65	62	G	Highway/Moderate traffic/ Open Area	
1235	--do--	N 30.87695 E 74.50919	185	70	52	Poor/Noisy	Open Area/ Highway	

# Reception survey for satisfactory coverage of HPT (TV) Transmitter (471.250MHz), Fazilka (Pb)

Direction: East & North-East (Radial-5)

Table-5

Route: Tower (Fazilka) – Malout-Muktsar-Ferozpur

Date: 26/05/2016

(Hrs)	Spot/Location	Location Co-ordinates	MSL (Mtrs)	Radial Distance (kM)	Field Strength (dBuV/m)	Subjective Assessment	Terrain	Remarks
1907	Malout Fazilka Road	N 30.39462 E 74.08604	166	5	83	E	Village / Open Area/Low Traffic	
1851	---do---	N 30.38452 E 74.13796	169	10	79	E	Village / Open Area/low traffic	
1834	---do---	N30.35451 E74.23577	180	20	76	E	Rural/Open Area / Low Traffic.	
1821	---do---	N 30.33315 E 74.28827	182	25	77	E	Rural / Low traffic	
1750	Vill: Bam	N 30.37387 E 74.34255	188	30	65	E	Village / Low Traffic	
1719	Muktsar Abohar rd	N 30.39264 E 74.39473	190	35	67	E	Open Area / low Traffic	
1706	--do--	N 30.41969 E 74.44653	190	40	59	Good	Low traffic/ Low density population	
1651	Abohar rd/ outskirts Muktsar	N 30.45624 E 74.49586	190	45	56	Fair	Low rise buildings/ Traffic	
1440	Ferozpur Muktsar rd	N 30.53713 E 74.53246	184	50	59	fair	Open Area/ Low Traffic	
1522	--do--	N 30.60271 E 74.55365	191	55	49	Poor	Vegetation/ Highway	
1510	--do--	N 30.67533 E 74.57455	192	60	62	Good	Open Areas/Low Traffic/No settlements.	
1443	--do--	N 30.60271 E 74.55365	195	70	56	Fair	Open Area/ low Traffic/ No settlements.	