

# **Affordable Solar Radio Telescope (ASRT)**

*Assembly / Instruction Manual*

**Radio Astronomy Winter School 2011 (RAWS 2012)**

**IUCAA-NCRA, Pune**

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## Preface

The Affordable Solar Radio Telescope is a radio telescope operating in the Ku band which extends from 12 to 16 GHz. As the name suggests, the cost of the radio telescope is minimal and it is designed such that it can be replicated by anyone and everyone. The cost of building has been kept low by using off the shelf equipment which is easily available anywhere in the world.

The telescope is primarily intended to observe the sun in this band viz. 10.7 to 12.75 GHz. but can just as easily be used for observing radiation from compact fluorescent lamps, human body, boiling water etc. as well. Although the radio telescope is easy to build and operate, that doesn't limit the science that can be done with it as it can be used to carry out several scientific endeavors both basic as well as advanced.

This manual gives step by step instructions for assembling the ASRT. Pictures have been included to make the steps more easy to understand and self-explanatory. As is so often the case, the manual was written and edited at a short notice and I thus apologize for any flaws and welcome comments and/ or corrections if any.

Vaibhav Savant  
(vaibhavsavant@gmail.com)

# Motivation

We all might have seen small optical telescope, but whenever it comes to radio, we never see any small version of it. Due to this many students don't get a chance of using a radio telescope. So here a method has been shown to design a portable radio telescope. The main idea here is to make it as cheap as possible, and use the items, which are available easily in the market. This will help to spur more interest towards radio astronomy. The telescope cost less than Rs1000 and can be designed very easily. It operates in the KU band i.e. 12 GHz to 18 Ghz.

# 1. List of components/ tools required:

## 1) Ku Band Dish antenna



## 2) Set Top Box



## 3) Satellite Finder



4) LNB



5) Co-axial Cable



6) F- type Connectors and Crocodile Clips



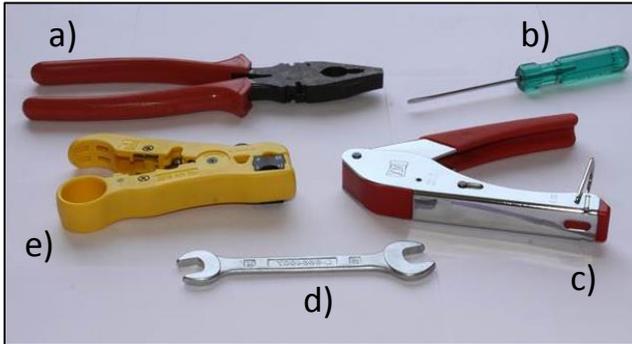
## 7) Mounting Stand and LNB Arm



## 8) Digital Multimeter

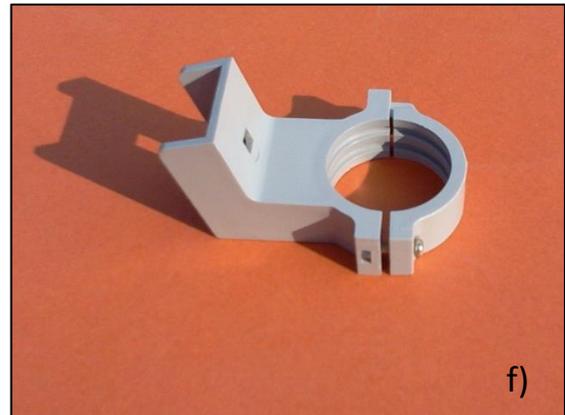
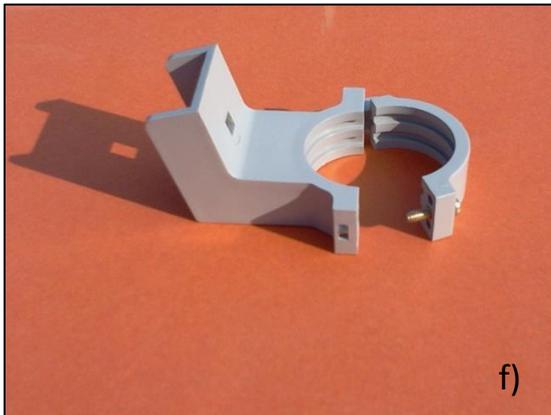
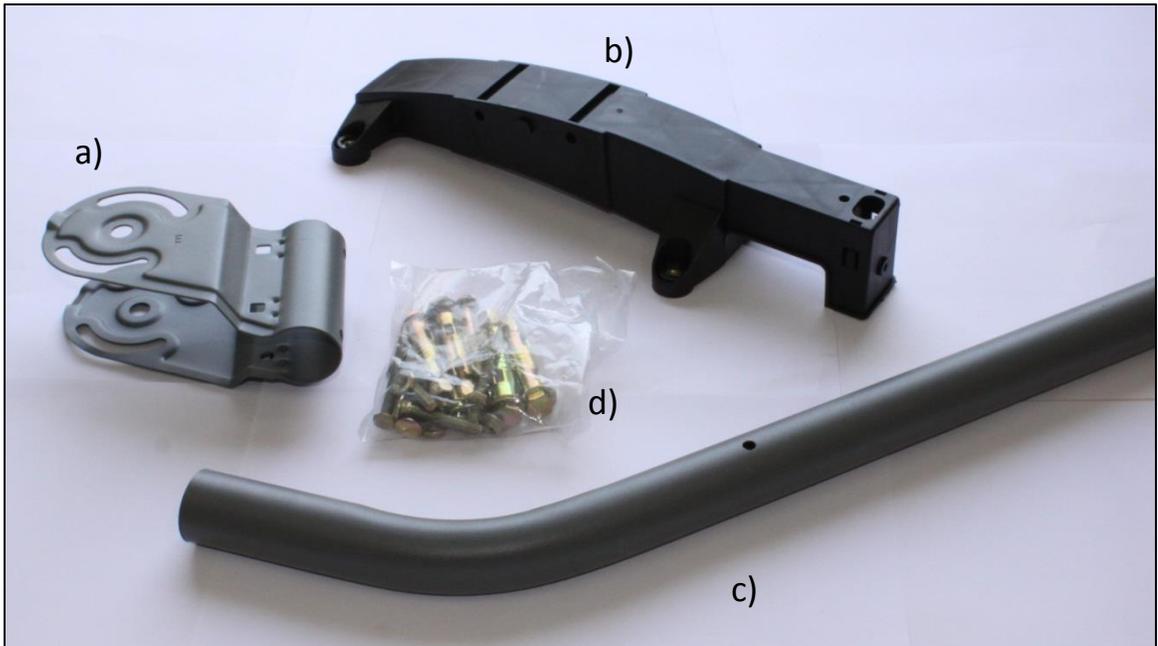


9) Miscellaneous tools



- a) Pliers
- b) Screw driver
- c) Compression type Crimping tool
- d) Spanner
- e) Cable Preparation tool

The commercially available DTH dish comes with following components for mounting

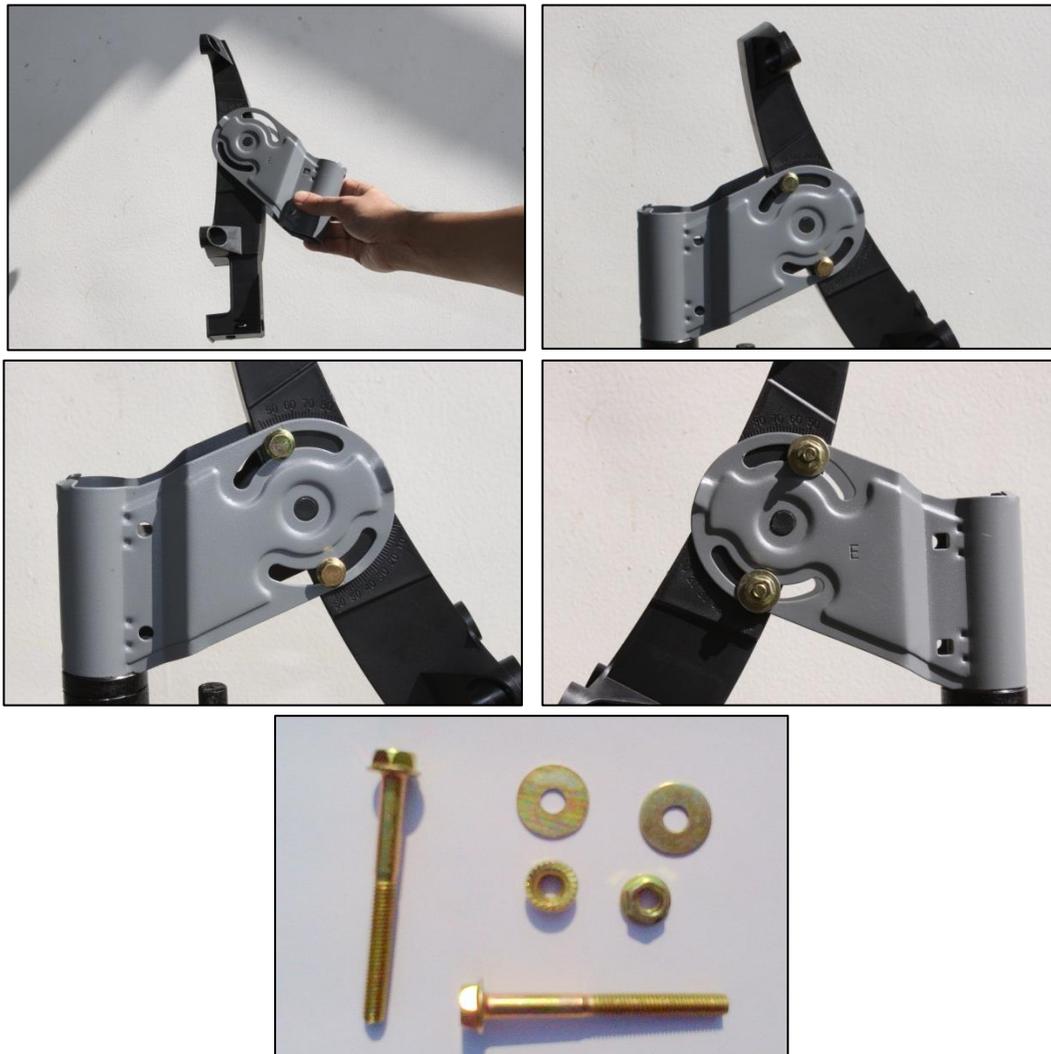


- a) Mounting Bracket
- b) Dish Holder
- c) Dish Arm (which will not be used!)

- d) Nut-bolts, Screws, Washers, etc.
- e) LNB Arm
- f) LNB Holder

## 2. Dish Assembly

**Step 1:** Insert the Mounting Bracket over the Dish Holder such that it clicks into the central stub of the Dish Holder. Ensure that the Mounting Bracket is the right side up (if it is oriented properly it should slant down when held with the mounting clamp roughly perpendicular to ground as shown – the part held in hand which clamps on to the stand is the mounting clamp.) Put the appropriate Nut bolts as shown but do not tighten them too much (don't forget to put the washers in before the nuts go on the bolts).



**Step 2:** Attach the dish holder to the dish using screws as shown. All the four nuts of the dish holder should be aligned properly with the fitting holes on the dish. After aligning the holder, simply screw in the appropriate screws (shown below) until they are sufficiently tight to hold the dish firmly.



**Step 3:** The dish can now be mounted on the stand by inserting the Mounting Bracket's clamp into the stand axle. Insert the LNB Arm, with the letters "UPSIDE" facing up, carefully into its holder at the bottom of the dish. Push it all the way in and ensure that it has clicked into place in the Dish Holder.



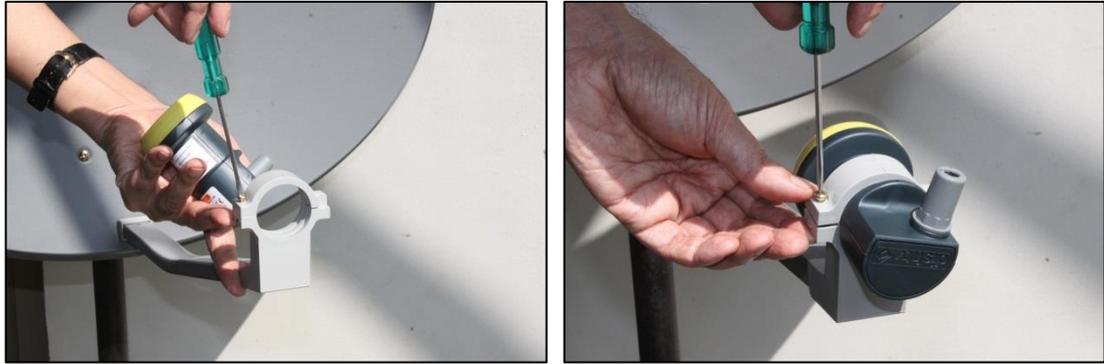
**Note:** Once the LNB Arm is in place do not try to remove it. The arm locks into place with the help of plastic locks. These can easily get damaged if the arm is pulled out after locking.

Also care should be taken not to put any unnatural stresses on the LNB arm to prevent it from bending and losing its alignment with the dish's focus.

**Step 4:** Connect the LNB Holder to the LNB Arm. Secure it with the appropriate screw. Ensure that the washer and nut is facing up and not the Bolt head.



**Step 5:** Loosen the LNB Holder screw and insert the LNB with the Feed side facing towards the dish into it. Tighten the screw so that the LNB stays in place but allow for some slack so that the LNB can be rotated within the holder.



This completes the dish assembly.

### 3. Cable connections:

Before the connections are done the connectors need to be crimped onto the cables. There are two cables – one 5 meter long and the other 3 meters. The longer cable (5 m.) is used to connect the LNB to the Satellite Finder. The shorter cable (3 m.) connects the Satellite Finder to the Set Top Box.

The crimping procedure will be demonstrated by the supervisors. Do not attempt to use the tools unless the procedure is understood. In case of doubt, check with any of the floor supervisors.

**IMPORTANT:** Do not switch on the STB or even connect it to a power outlet until all the connections are complete and are approved by the supervisors.

**WARNING:** Exercise extreme caution while using the Preparation Tool. Keep fingers away from the cutting blades. Improper use can easily sever finger/s!

**Step 1:** Take one piece of cable (5 m.) and connect it to the LNB of dish. Connect the other end of the cable to the Satellite Finder. Ensure that this end is connected to the “LNB IN” connector only. This is marked on underside of the Satellite Finder.



**Step 2:** Take the smaller cable (3 m.) and connect one end to the STB. The cable should be connected to the “IF IN” connector on the back of the STB and NOT to “IF OUT”. Connect the other end to the Satellite Finder at the “TO REC” connector marked on the underside of Satellite Finder.



The dish setup is now ready.



\* The pictures show the dish with the LNB Arm connected upside down. The LNB Arm should be connected such that the “UPSIDE” letters face up towards the sky after connecting it to the dish.

## Experiments:

1. Detecting CFL and incandescent bulbs.
  - a. Point the dish to the wall and adjust the knob of the satellite finder so that the reading is between 2-3.
  - b. Point the dish towards the incandescent bulb and note the output in the multi meter.
  - c. Now change the CFL bulb with the incandescent bulb and note the output.
2. Detecting Sun.
  - a. Point your dish away from Sun and from any satellites (How would you know that you are not looking at any Satellite?) and adjust the knob of the satellite finder so that the reading is between 2-3.
  - b. Now point your dish to the Sun by using the mirror attached to the dish.
  - c. Now slowly move the dish away from Sun (in alt and azimuth) and you will see the decrease in the output.
3. Detecting Geo Stationary satellites.
  - a. Point your dish away from Sun and from any satellites (How would you know that you are not looking at any Satellite?) and adjust the knob of the satellite finder so that the reading is between 2-3.
  - b. Use sites like <http://www.dishpointer.com/> to locate some geostationary satellite and point at them.
  - c. Note the output.