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Dish Antenna with Solar Power Generation

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Abstract - In this age of electronics, we need electrical power for everything from our smallest needs to the biggest of needs. But in today's world we are facing major crisis in the field of electrical power. So in this paper we have come up with the idea of saving and generating energy for everyday normal use. In this paper we are using dish antenna for dual purposes :

1. To receive the T.V signals.
2. To generate electricity with the help of solar panels.

In this paper we have discovered that only 30% of the Dish Antenna is sufficient to receive a good quality of signals. So the rest 70% is used for energy production using solar panels. We are mounting solar panels on the dish antenna to generate the energy. A few of the panels will be charging a battery with the help of a charging circuit and the remaining panels will deliver power to the Set-top box directly. If the sunlight will be sufficient during day time then it will run the Set-top box as well as charge the battery, and during night time the battery will provide the supply to Set-top box. We can use this power for some other purposes too. With this idea we can save

1) Few watts of energy
2) Additional area used by the Solar panels (e.g. on the terrace)

Most importantly it is a green source of energy.

I. INTRODUCTION

Every household now has a TV set, and many are subscribers to the direct-to-home plan involving a Dish antenna and Set-top-box.

Conventional wisdom says that the dish antenna for a Dish TV arrangement collects the beamed signals and focuses the beam on to the Feedhorn – the device which is mounted in front of the dish and connects to the set-top-box. Different brands of Dish TV use dishes of different sizes though the picture quality remains about the same. Also, the Feedhorns used by different brands were more or less of the same size. Since the signal broadcasted TV signal is the same, we can hypothesize that perhaps the entire dish surface is not needed for a good reception.

A small experiment to test the hypothesis was conducted by progressively covering the surface of a standard Dish Antenna with thermocole slabs to block the signal and observing the TV picture. It was found that only about 30% of the dish area is necessary for obtaining a good TV signal. This implied that 70% of the dish area was not strictly necessary for TV reception.

This paper was framed around this idea, and it was decided to line this large 'free area' with solar cells and generate electricity. The Dish TV setup would then serve its primary function as well as provide an alternate source of clean energy.

Figure : 1 Hardware Layout

The solar panels are mounted on the surface of the dish antenna as seen in the picture, and the output goes to charge a 12V 7AH SMF battery through a voltage regulated charging circuit. A voltage regulated charging circuit allows the battery charging cycle to shift from full charge to trickle charge as required. In the prototype unit, the battery is used to run the set-top-box.

II. WORKING

A satellite dish is a dish shaped type of parabolic antenna designed to receive microwaves from communications satellites, which transmit data transmissions or broadcasts, such as satellite television.

The parabolic shape of a dish reflects the signal to the dish's focal point. Mounted on brackets at the dish's focal point is a device called a feedhorn. This feedhorn is

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essentially the front-end of a waveguide that gathers the signals at or near the focal point and conducts them to a low-noise block down converter or LNB. The LNB converts the signals from electromagnetic or radio waves to electrical signals. Direct broadcast satellite dishes use an LNBF, which integrates the feedhorn with the LNB.

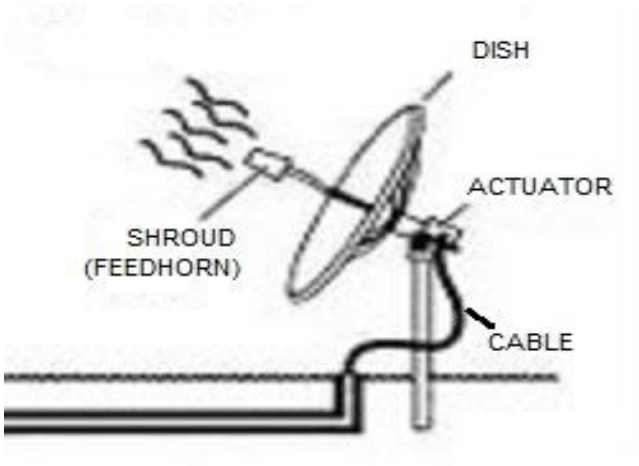

Figure:2 Parts of a Dish Antenna

The basic satellite dish consists of the following materials:

- A parabolic reflector made of fibreglass or metal, usually aluminium, with a protruding mounting arrangement for the feed horn system.
- A steel actuator that enables the dish to receive signals from more than one satellite.
- The feedhorn is enclosed in a metal (usually aluminum) shroud so as to reduce side interference. The feedhorn with shroud is mounted about 10cm to 45 cm away from the dish along its focal axis.
- Cables, usually copper, in weather-proof vinyl insulation.

Curvature of the Dish:

A common misconception is that the dish is a pure parabola. This implies the focal point is along the centre of the dish. However, the dish is actually an asymmetrical segment of a paraboloid, with the result the focal point is shifted towards one edge. The purpose of this design is to move the feed structure out of the beam path, so it doesn't block the beam. The LNBF is therefore mounted towards one edge of the dish. The LNBF is by itself sufficient to receive signals, and the dish merely serves to increase the signal density. For instance, one BBC News downlink shows a signal being received by the LNBF directly instead of being beamed to the dish. We have made use of this and will use a portion of the dish to generate electricity while leaving sufficient area for collecting signals.

SOLAR CELLS

A solar cell (also called photovoltaic cell or photoelectric cell) is a solid state device that converts the energy of light directly into electricity by the photovoltaic effect

Solar Panel Used

We have used two types of Solar Panels:

- Monocyrstalline type
- Amorphous type

Benefits of Monocrystalline Solar Panels are:

1. Longevity
2. Efficiency
3. Greater Heat Resistance
4. Eco-friendly materials
5. Lower Installation Costs and Maintenance costs

Benefits of Amorphous Solar Panels are:

1. Has a higher absorption rate of light than crystalline cells
2. Low cost per Watt of power generated
3. Low processing temperature

III. SPECIFICATIONS

The Solar Panel we used has the dimensions of 145 ×155mm., and each Panel rated at 12V and 4W. However we have only limited area. So, we could use only 10 panels of which seven were monocrystalline and three were of amorphous type. According to our experiments, each Solar Panel of amorphous silicon was giving around 6V and 0.22A while the monocrystalline was giving 11V and 0.14A as against the rated 12V and 4W. Since the output voltage depends on the intensity of sunlight, we have used different connections as the base for desired power requirement.

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TABULATION

No. of blocks	Size in m^2	Video quality	Audio quality
1	0.023	Good	Good
2	0.046	Good	Good
3	0.069	Good	Good
4	0.092	Good	Good
5	0.115	Good	Good
6	0.138	Good	Good
7	0.161	Good	Good
8	0.184	Good	Good
9	0.207	Good	Good
10	0.23	Good	Good
11	0.253	Bad	Bad

Table:1 Showing the quality of TV signals

The above table shows the affect on audio and video signals on using different number of solar panels. When we used only one panel then the audio and video signals were good. So we kept on increasing the number of panels till ten numbers of solar panels we were getting good signals but as we tried for 11^{th} one we faced audio and video signal problem, so, we stopped on 10^{th} panel. After conducting this experiment we decided to use 10 no.of panels and fixed them on the dish. Hence, the quality of signals sustained even after the fixing.

IV WORKING OF DISH-TV CUM SOLAR PANEL

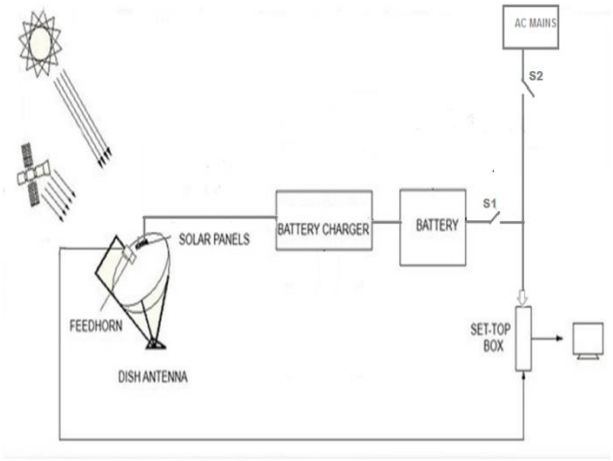

Figure:3 Block diagram of proposed system

The block diagram of the concept shows that the DISH TV with solar panels feed the battery with the help of charging circuit and then from battery it is going to set-top box. The set-top box is connected with the TV. So from the dish we are getting signals as well as we are running the TV also. In the absence of sun and battery we can run the set-top box with AC source also.

Tabulation of power with respect to Sun radiation:

Time	Voltage (volts)	Short circuit current (Amps)
9:30 am	15	0.41
10:00 am	15	0.44
10:30 am	15	0.47
11:00 am	15	0.46
11:30 am	15	0.47
12:05 pm	15.1	0.41
12:30 pm	15.1	0.38
1:00 pm	15.1	0.36
2:00 pm	15.1	0.24
3:05 pm	15.1	0.19
3:43 pm	15.1	0.11

Table:2 Time vs Solar Panel Output

It is seen that the voltage is maximum around 2 o'clock at noon and moreover it is almost constant for approximately 8 hours, which is sufficient to charge the battery

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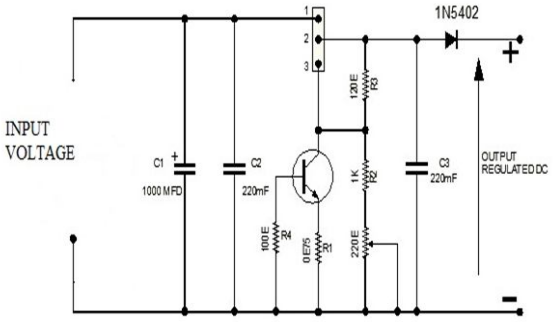
V CHAGING CIRCUIT



A Battery Charging Circuit is a circuit that regulates the power generated by the Solar Panels to a power required for charging a battery. The heart of the circuit is IC LM317, which is an adjustable positive voltage regulator IC. The pin 1 of the IC is the control pin which is used to control the output voltage. The pin 2 is the output pin at which the regulated output voltage appears. The pin 3 is the input pin to which the un-regulated DC input supply is given. The charging voltage and current is controlled by the Transistor Q1, resistor R1 and variable resistor R5. When the battery is first connected to the charging terminals, then the current through R1 increases. This in turn increases the current and voltage from LM 317. When the battery is fully charged the charger reduces the charging current and the battery will be charged in the trickle charging mode.

VI FUTURE ASPECTS

Probable Application

Such as;

- In almost all homes, a dish antenna is available. So, a dual function dish antenna can be easily used in homes for lighting, charging and can be used to run low power electrical devices.
- Mobile broadcasting vans, also known as outside broadcasting vans are used for remote coverage of an event, using a range of standard broadcasting facilities. As it is under the sun during the day time the paper concept can be used to its maximum.
- The concept can be used in sailing ships. As the ships communicate to the land system through satellite for transmission and reception, these solar plated antennas can be used for storing energy without hampering its usual work.
- Also, in defence sectors the purpose can be served.
- The power generated can also be used for decorative lightings and fish tank.

PROBABLE IMPROVEMENTS

Every devices need improvements as the demand increases. In our paper the probable improvements can be,

Use of reflectors:

Reflectors are used to collect or project energy such as light, sound or radio waves. For our project, we can use mirror, as it is the best reflector to project light energy coming from sun to the panels. Hence, with this maximum energy can be generated from the limited number of panels. For this, mirrors can be fixed at the periphery of the dish in such a way that sun rays are not blocked.

Better solar panels:

The second and the important improvement can be the use of more efficient solar panels. For example: use of organic solar panels which are flexible and 33% more efficient when compared with conventional one.

Use of Anti Reflective material:

It may also be possible that the area which we have left for the reception of T.V signals can be taken into account, if anti reflective materials against radio signals are used. If so, then 100% of the dish can be used for generation.

Area Details:

Assuming the dish be circular, the geometry of the "VIDEOCON" dish are:

Diameter = 65m
Circumference = 202.5 m
Total area, = 0.33183 m^2.

Calculation of Area:

Experimentally found :

Area used by the TV signals = $(30\times32.5)\ m^2$.=0.0975 m^2

Usable area left for the use of solar panels

= $(0.33183 - 0.0975)\ m^2$

= $0.23433 m^2$.

Percentage of effective area used by solar panels

= $(\frac{0.23433\times100}{0.33183})$

= 70.6%

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Applications:

a. In normal homes.
b. In Mobile Broadcast Vans.
c. In Sailing ships.
d. Defence purposes

Limitations:

1. Irregular Power generated :
2. Unavailability of desired solar panels:
3. Insufficient power supply to the set top box:
4. Sun tracking is not possible:

VII CONCLUSION

A method of designing a dish antenna that serves two purposes was designed and demonstrated in this paper. This paper was framed around this idea, and it was decided to line this large 'free area' with solar cells and generate electricity. The Dish TV setup would then serve its primary function as well as provide an alternate source of clean energy. The crux of the work is that the whole process is done at the least possible cost and it is affordable for practical implementation. In future we may see all the dish antennas plated with solar panels.

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