# Comparison between SSPA and Magnetron X-band radars in maintenance field

Sun-Jin Mo, Ji-Young Gu, and Geunhyeok Ryu

*Weather Radar Center, Korea Meteorological Administration, Republic of Korea*

## MOTIVATION

- **The Korea Meteorological Administration installed mobile magnetron X-band radar in 2009 and operated it until 2017.**
- **In 2017, three SSPA radars were introduced and now in operation. Various maintenance problems occurred while operating these two different transmitter-type radars, and I would like to explain the advantages and disadvantages of them.**

## SPECIFICATION

Magnetron type Transmitter

| Antenna Type | Parabolic reflector |
|---|---|
| Antenna Diameter | 2.44 m |
| Beam Width | 1.0° |
| Type | Magnetron (PSI) |
| Maximum Voltage | 180 kW (90 kW simultaneous H/V) |
| Frequency | 9360 MHz (X-band, λ=3.2 cm) |

SSPA type Transmitter

| Antenna Type | Parabolic reflector |
|---|---|
| Antenna Diameter | 1.8 m |
| Beam Width | 1.27° |
| Type | SSPA |
| Maximum Voltage | 1 kW (H,V channel) |
| Frequency | 9360 MHz (X-band, λ=3.2 cm) |

## INSTALLED IMAGE

Magnetron type

(a) (b)

SSPA type

(c)

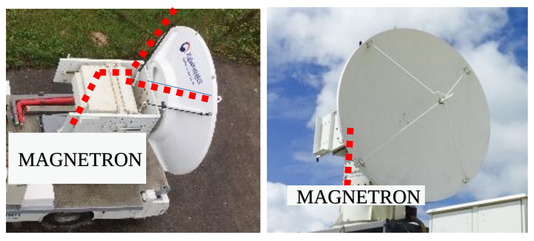
- **The magnetron-type radar is mounted on a vehicle and could be observed while moving.**
- **In addition, it could be detached from the vehicle and installed on the tower so that it could be fixed.**
- **SSPA-type radars are operated in the form of network**
- **Fig(a) Fixed installed magnetron type radar**
- **Fig(b) Vehicle-mounted mobile magnetron type radar**
- **Fig(c) 3 SSPA type radars installation**

## ADVANTAGES OF SSPA-TYPE RADAR OVER MAGNETRON TYPE RADAR

### CAUSE 1

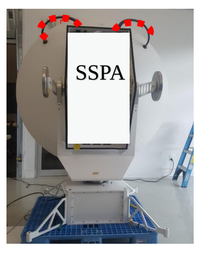
- **A magnetron-type radar has a modulator at the bottom of the pedestal, which must pass through a long waveguide until it radiates to the feed horn, and the longer the waveguide, the higher the risk of leakage.**
- **However, a SSPA-type radar has a lower risk of leakage because the transmitter is located behind the radar antenna and the waveguide is also flexible and short.**

(a)




- **Fig(a) Magnetron and hard type long wave-guide**

(b)




- **Fig(b) SSPA and flexible, short wave-guide**

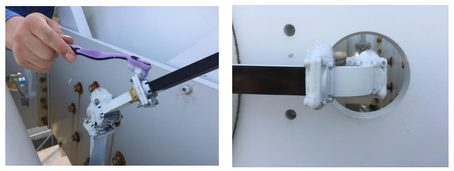
## ADVANTAGES OF SSPA-TYPE RADAR OVER MAGNETRON TYPE RADAR

### CASE 2

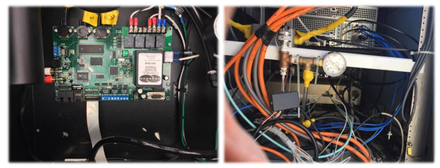
- **A Magnetron-type radar requires the use of dehydrators to maintain high pressure and low humidity to prevent arcing inside the waveguide, and these high pressures often break the feed horn and wave-guide connection point.**

(a)

(b)



(c)

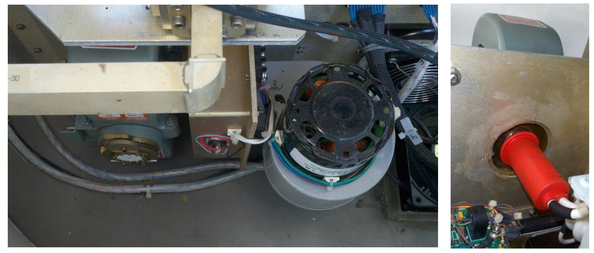


- **Fig(a) Broken feed horn and connector**
- **Fig(b) The point of pressure leakage**
- **Fig(c) Replacement of main board due to the dehydrator failure and addition of pressure control valve**

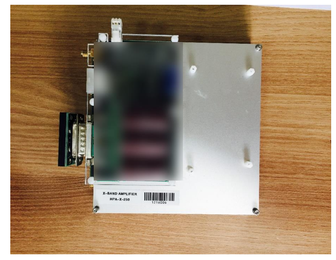
### CASE 3

- **The magnetron type transmitter inevitably causes a change in frequency due to the nature of the oscillation type. There is some frequency fluctuation within the OBW due to external temperature and self-generated high temperature and pressure.**
- **However, the SSPA-type radar transmits only a precisely determined frequency due to the characteristics of the oscillation method. Because of this small frequency change, crosstalk is less likely to occur when similar frequency bands are mixed.**
- **Additionally, from a maintenance standpoint, SSPA radars operate at very low voltages as specified in the specification table, allowing engineers to maintain them relatively safely during maintenance, and the equipment is modular.**
- **The advantage of module repair is that the radar can be operated normally by replacing the module.**

(a)



(b)



- **Fig(a) Magnetron radar blower and high voltage connection image**
- **Fig(b) SSPA radar power amplifier module**

## Summary and Conclusion

- **Most of the existing X-band radar transmitters used magnetrons, but recently, SSPA-type transmitters have begun to take their place.**
- **Existing magnetron-type radar was stopped due to feed horn breakage due to high pressure of waveguide, waveguide breakage, and it's arc caused by foreign matter inside the waveguide.**
- **Since SSPA type uses pulse compression technique, there is a discontinuity caused by the difference between long pulse and short pulse.**
- **However, in terms of equipment operation, SSPA radars are being operated stably enough to offset these shortcomings, and the operating rates of the three SSPA units operating in the WRC for the past three years are 92%, 99.7%, and 97%, respectively.**

## Acknowledgement

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## Contact information

- **Name : Sun-jin MO**
- **E-mail : mosunjin@korea.kr**