Feed-horn with circular polarization for parabolic dish

Zdenek SAMEK – OK 1 DFC
Why septum transformer?

- Necessary use circular polarization over 1 GHz
- Possibility use feed for LCP and RCP without 90° hybrid and TX-RX switching
- Saving 1.5 dB on the RX and TX site
- Saving money for expenses High power relay.
- Advantage that between TX and RX sites are loss more then 26 dB
- Good impedance adaptation both TX and RX ports
- Very easy possible set up high SWR
Electric diagram of septum

VE 4 MA – W 2 IMU – system

Septum-feed – OK 1 DFC

Hybrid

Relay for high power

Preamp

50R 30W

RX port

CX520 relay

50R 1W

TX port

Preamp

RX

TX

TX
How is it working?
Driving of transformer

Vertical part of electromagnetic wave

1. Four-square wave guide on the feed input
2. Septum transformer
3. Rectangular wave guide in RX – TX part, very close to by connector
Driving of transformer

Horizontal part of electromagnetic wave

1. Four-square wave guide on the input
2. Septum transformer
3. Rectangular part of RX and TX wave guide
RX – connector for receiving cable
TX – connector for transmitting cable
D1 – D2 – compensation capacitors for set up SWR
A – Rectangular parts RX - TX
B – Transformer
C – For-square output wave guide
- Diagram of circularity
- Theoretical maximum of discircularity is \(-1,1\) dB
- With not correctly calculate septum transformer will be diagram as a „cake“
Measurement diagram in unreflecting chamber TX

Směrové charakteristiky ozařovače Septum 2,3 GHz

-20
-25
-30
-35
-40
-45
-50
-55
-60
0 30 60 90 120 150 180 210 240 270 300 330 360

[dBm]

[°]

P konektor, rovina kolmá na konektory, vysílaná Vert. polarizace, 2,3 GHz [dBm]
P konektor, rovina rovnoběžná s konektory, vysílaná Vert. polarizace, 2,3 GHz, přívodní kabel na 270 s t. [dBm]
P konektor, rovina rovnoběžná s konektory, vysílaná Hor. polarizace, 2,3 GHz, přívodní kabel na 270 s t. [dBm]
P konektor, rovina kolmá na konektory, vysílaná Hor. polarizace, 2,3 GHz [dBm]
Measurement diagram in unreflecting chamber RX

Směrové charakteristiky ozařovače Septum 2,3 GHz

L konektor, rovina kolmá na konektory, vysílaná Vert. polarizace, 2,3 GHz [dBm]
L konektor, rovina rovnoběžná s konektory, vysílaná Vert. polarizace, 2,3 GHz, přívodní kabel na 90 st. [dBm]
L konektor, rovina rovnoběžná s konektory, vysílaná Hor. polarizace, 2,3 GHz, přívodní kabel na 90 st. [dBm]
L konektor, rovina kolmá na konektory, vysílaná Hor. polarizace, 2,3 GHz [dBm]
Comments

- We saw that circularity is absolutely perfect
- Diagram was done for 2,3 GHz feed
- Measurement condition-unreflecting chamber of Electro-technician University Praha
- Radiation angle 130° for –10 dB
- Practical use for dish with 0.35 F/D
- For other F/D is possible use with choking collar like VE4MA feed. Practical solution has Franta OK1CA
For calculation you must write only input frequency

<table>
<thead>
<tr>
<th>Frequency</th>
<th>1296 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcul of wave length</td>
<td>231,461 mm</td>
</tr>
</tbody>
</table>

**Calculation of septum transformer on picture**

<table>
<thead>
<tr>
<th>Mesze</th>
<th>distance in mm</th>
<th>Lambda</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>78.2</td>
<td>0.338</td>
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<tr>
<td>B</td>
<td>138.2</td>
<td>0.597</td>
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<tr>
<td>C</td>
<td>200.9</td>
<td>0.86</td>
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<tr>
<td>D</td>
<td>222.5</td>
<td>0.961</td>
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<tr>
<td>E</td>
<td>370.4</td>
<td>1.6</td>
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<tr>
<td>F</td>
<td>18.5</td>
<td>0.08</td>
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<tr>
<td>G</td>
<td>41.2</td>
<td>0.178</td>
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<tr>
<td>H</td>
<td>69.7</td>
<td>0.301</td>
</tr>
<tr>
<td>I</td>
<td>113.7</td>
<td>0.491</td>
</tr>
<tr>
<td>J</td>
<td>144.9</td>
<td>0.626</td>
</tr>
</tbody>
</table>

**Long of tooth**

<table>
<thead>
<tr>
<th>Mesze in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from output on feed and transformer</td>
</tr>
<tr>
<td>Distance between dipol and rear wall</td>
</tr>
<tr>
<td>Dipol long</td>
</tr>
<tr>
<td>Total of feed length</td>
</tr>
</tbody>
</table>

**Picture of transformer**
Comments

- We saw that calculation is in Excel very comfortable
- All dimensions are in mm
- Material for feed is Aluminum or Cooper sheet
- Do not use bras, problem with freeze
- For frequency up to 2.3 GHz accuracy up to 0.5 mm
- Higher frequency up to 0.1 mm
Types of septum transformer

1. Sloping septum
   - isolation RX-TX 25 dB max.
   - discircularity 2 – 3 dB
   - easy for producing

2. Chen and Tsandoulas septum
   - isolation RX-TX up to 27,5 dB max.
   - Maximum of discircularity 1,1 dB
   - Circularity for very wide frequency range +,- 10% of calculation frequency
Practical solution of feed

Feed for 1296 MHz – practical solution
Assembly of on the RX port for 1296 MHz
Assembly of feed – look to compensation capacity screw.
Application of feed by OK 1 UWA for 1296 MHz
Feed with funnel by OK 1 CA for 2320 MHz and Cassegrain mirror
Thank you for your attention – GL and 73 ! OK 1 DFC