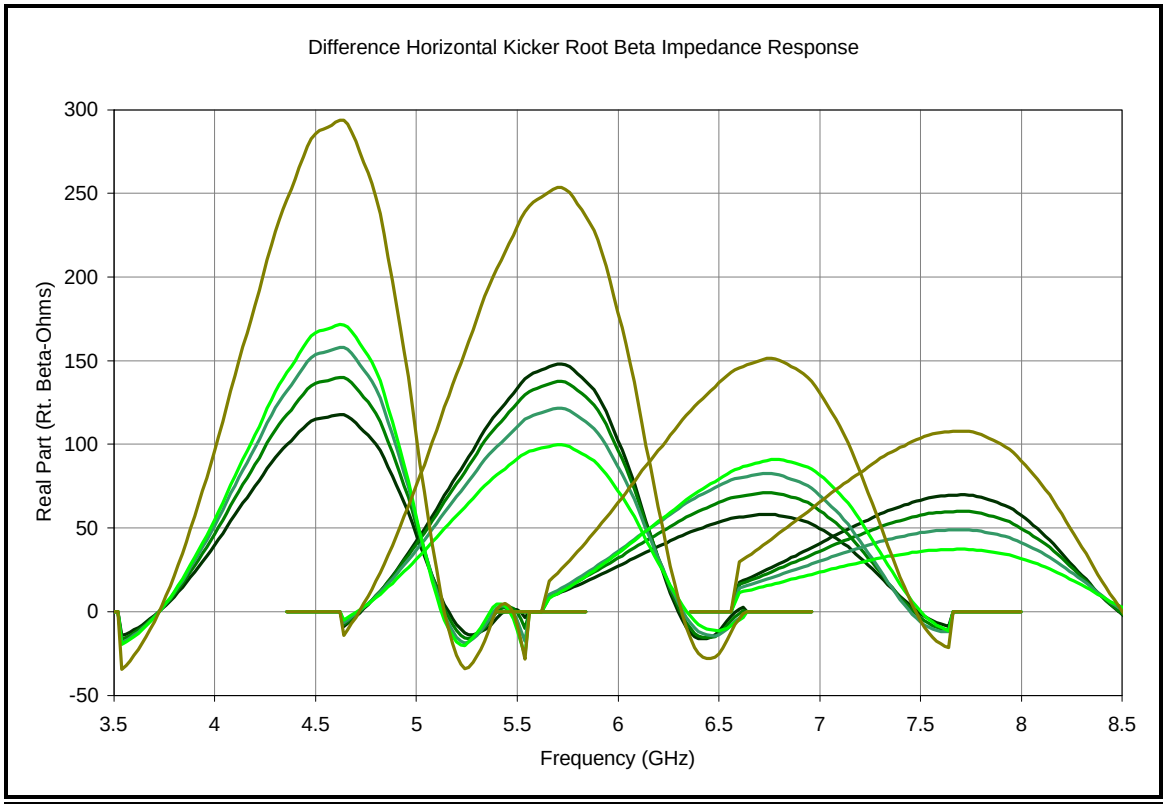
PBAR NOTE 580
4-8 GHZ DEBUNCHER UPGRADE ARRAY IMPEDANCE RESPONSE

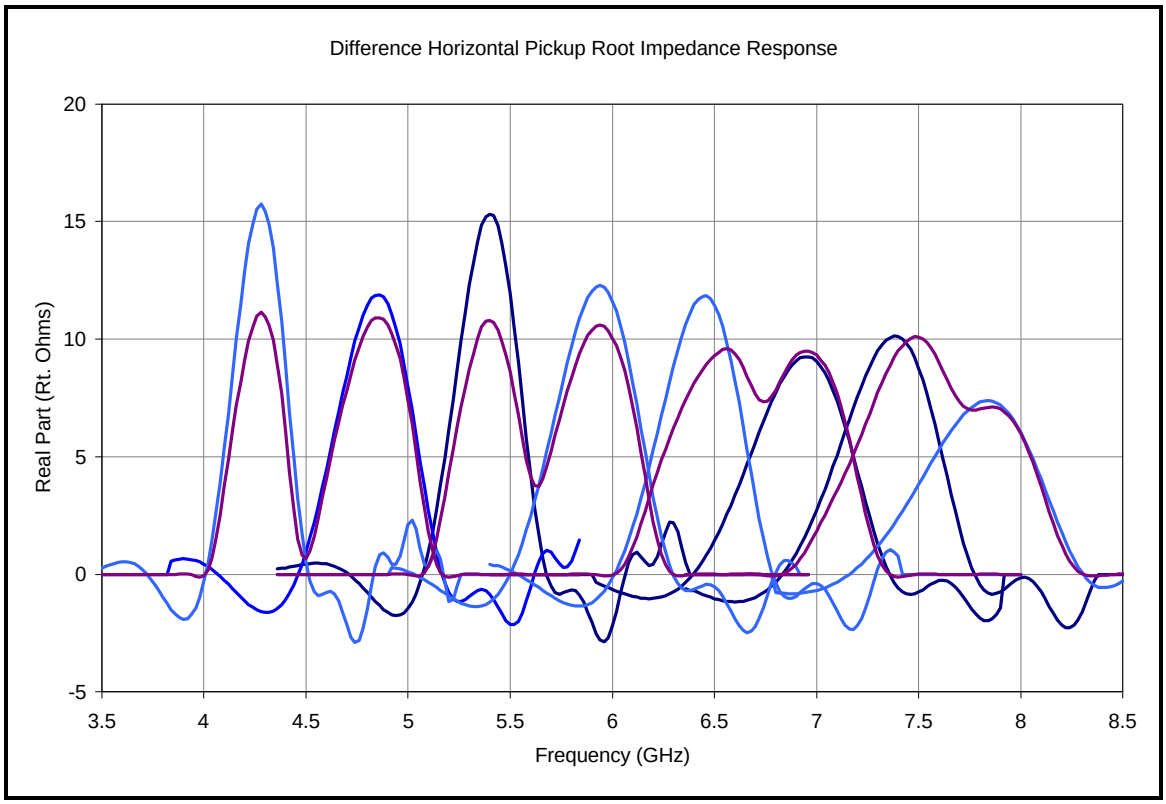
Dave McGinnis

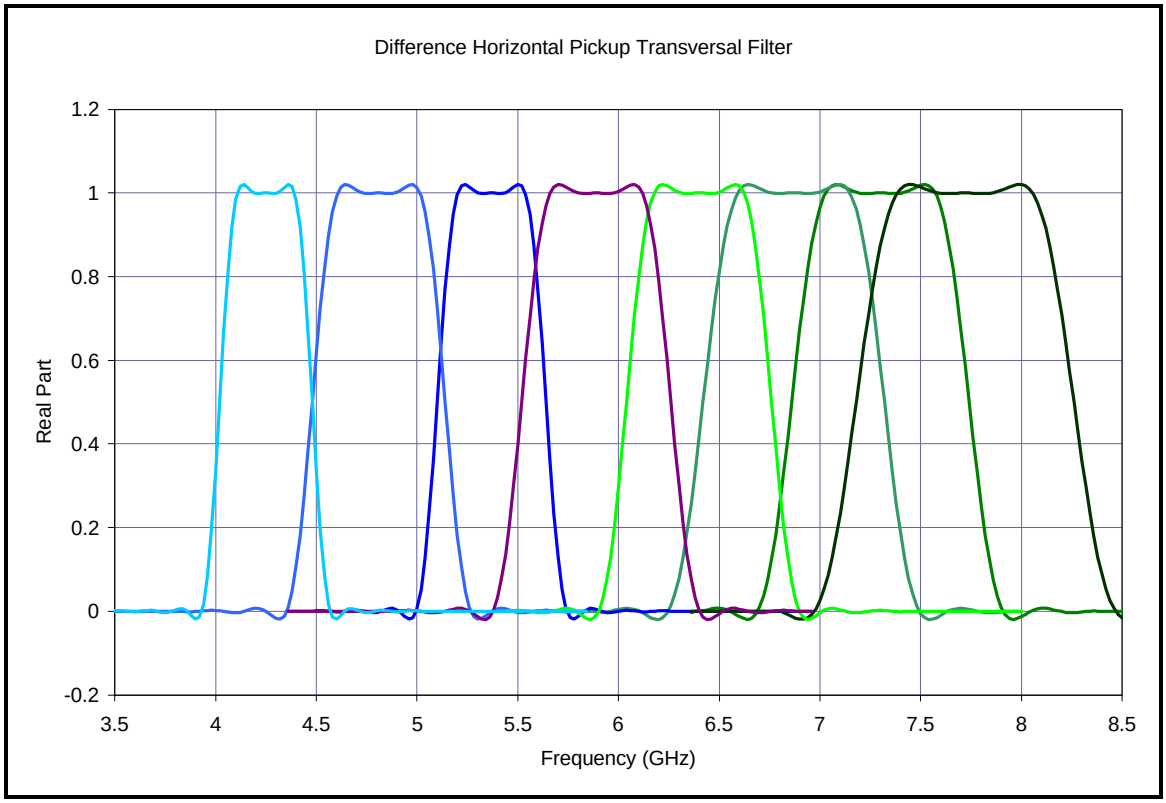
March 22, 1998

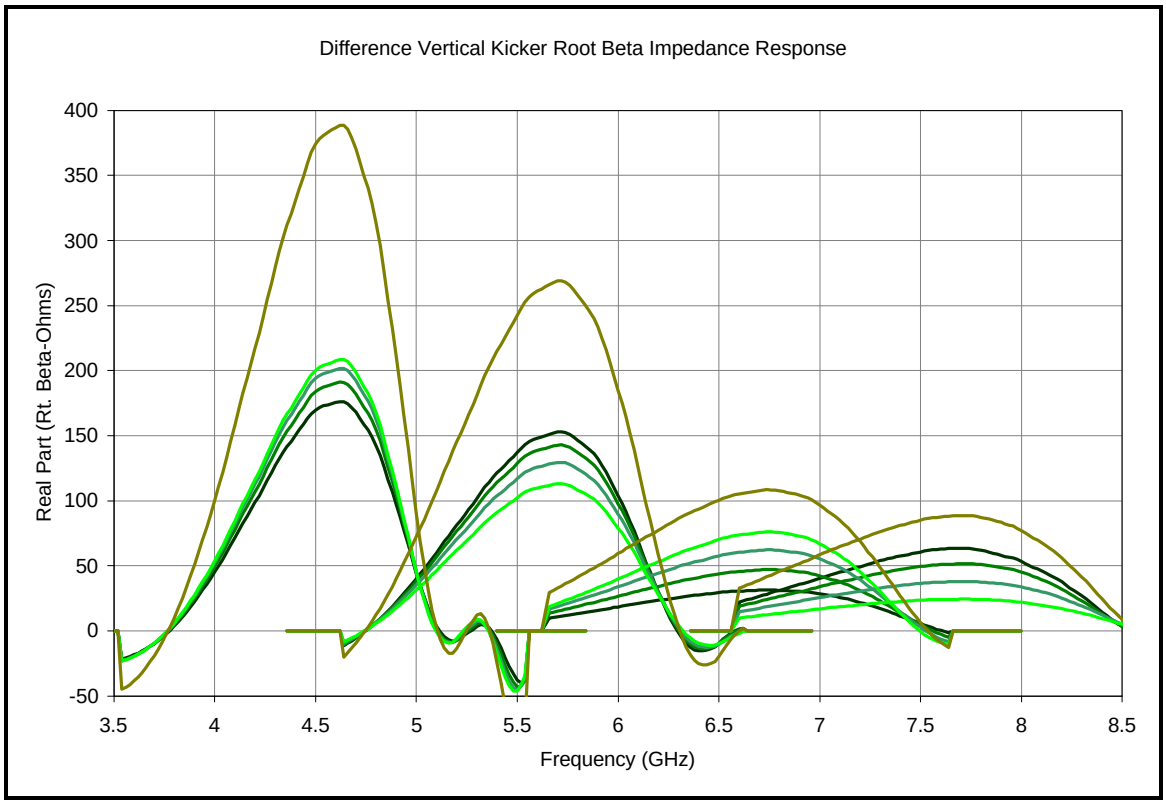
Color Legend

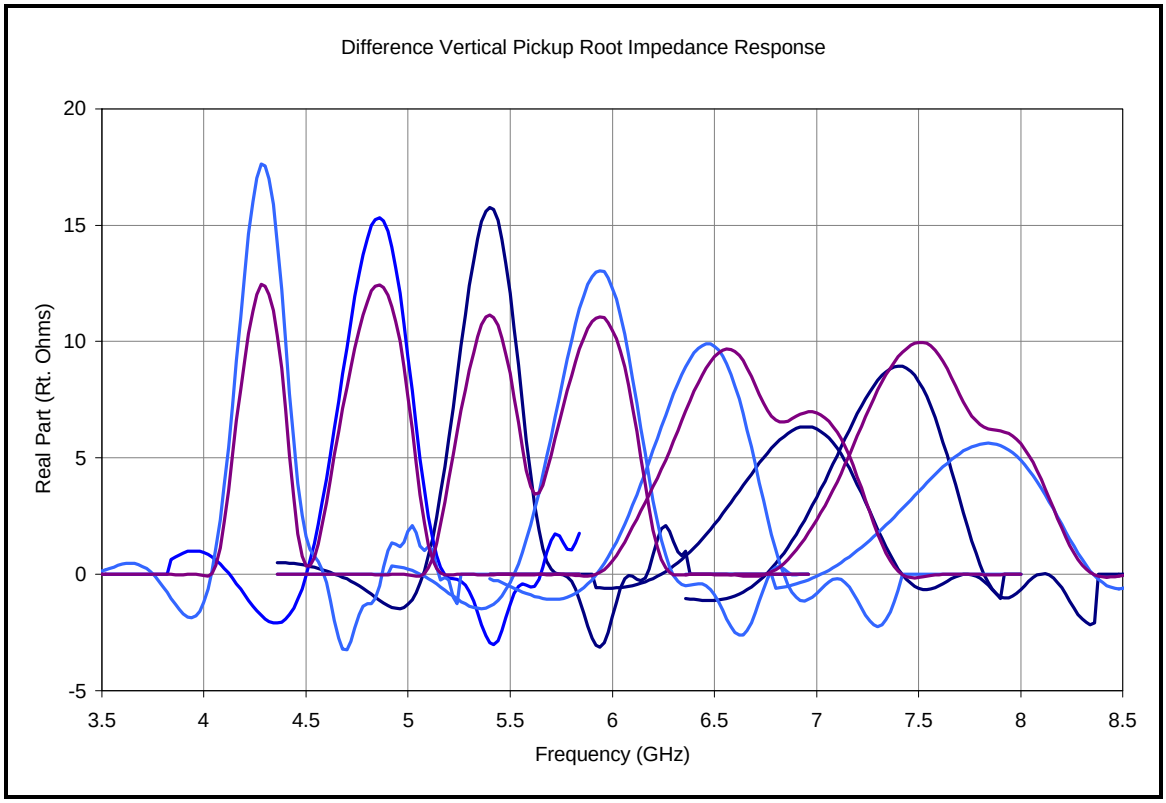
Dark Yellow	Power Sum of Kickers
Dark Green	Kicker 1
Green	Kicker 2
Sea Green	Kicker 3
Bright Green	Kicker 4
Dark Blue	Pickup 1
Light Blue	Pickup 2
Violet	Power sum of pickups

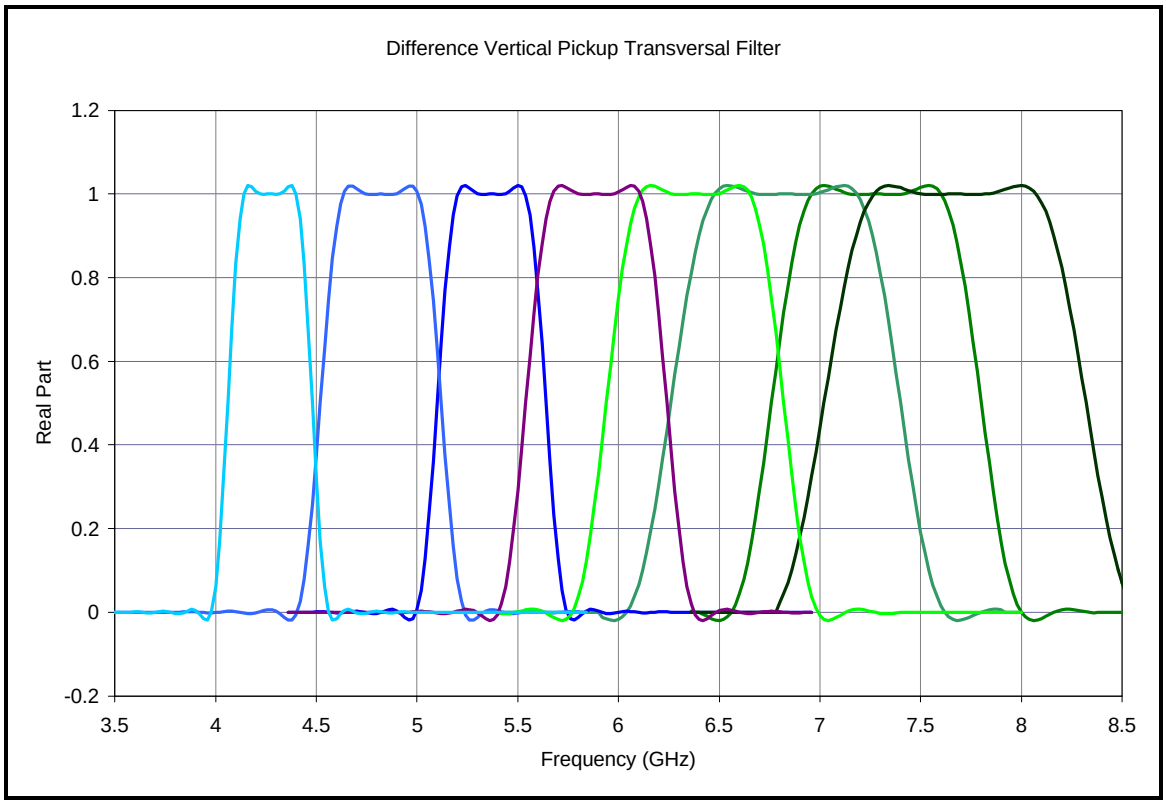


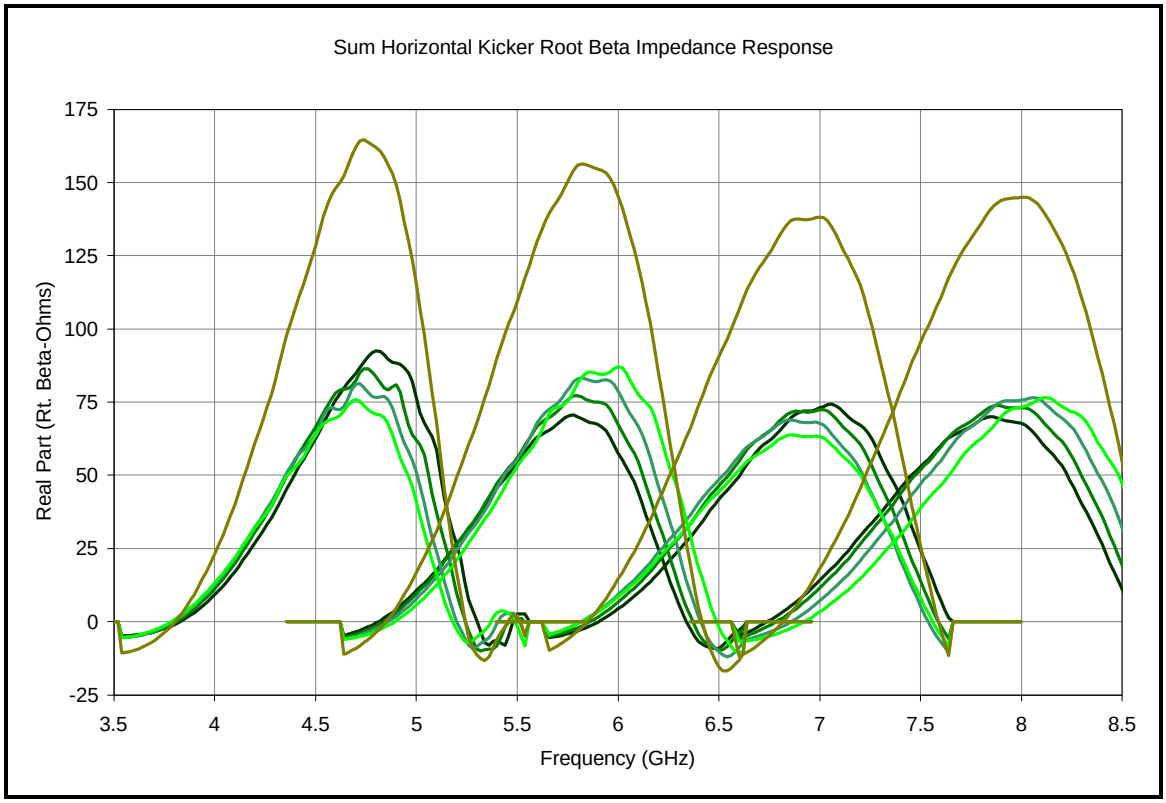

Difference Horizontal Pickup Root Impedance Response
Real Part (Rt. Ohms)
20
15
10
5
0
-5
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)

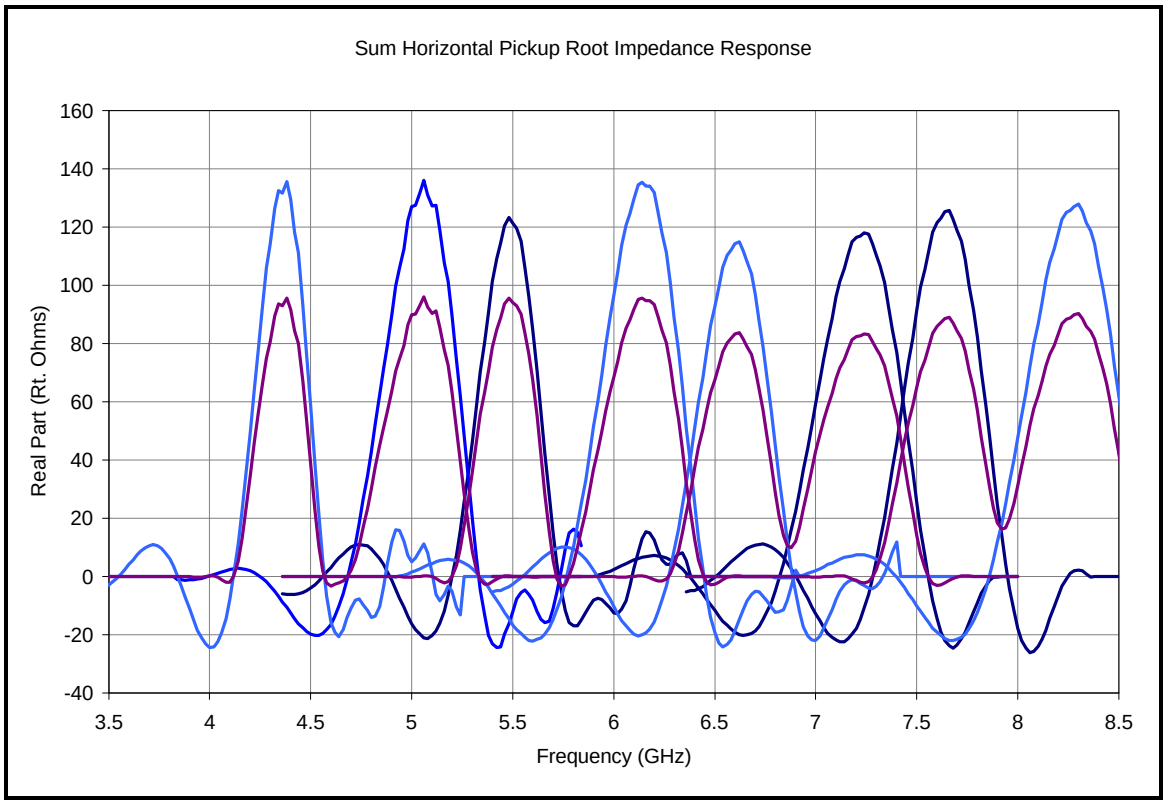

Difference Horizontal Pickup Transversal Filter
Real Part
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)

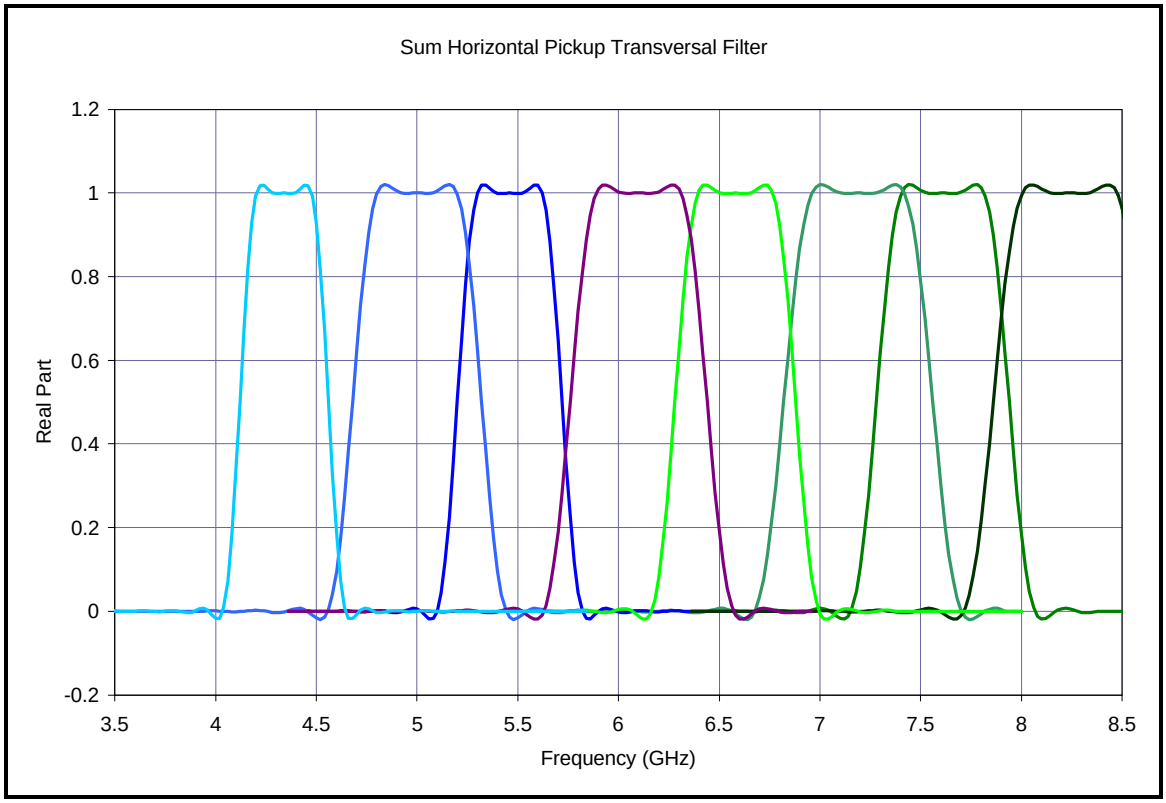

Difference Vertical Kicker Root Beta Impedance Response
Real Part (Rt. Beta-Ohms)
400
350
300
250
200
150
100
50
0
-50
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)

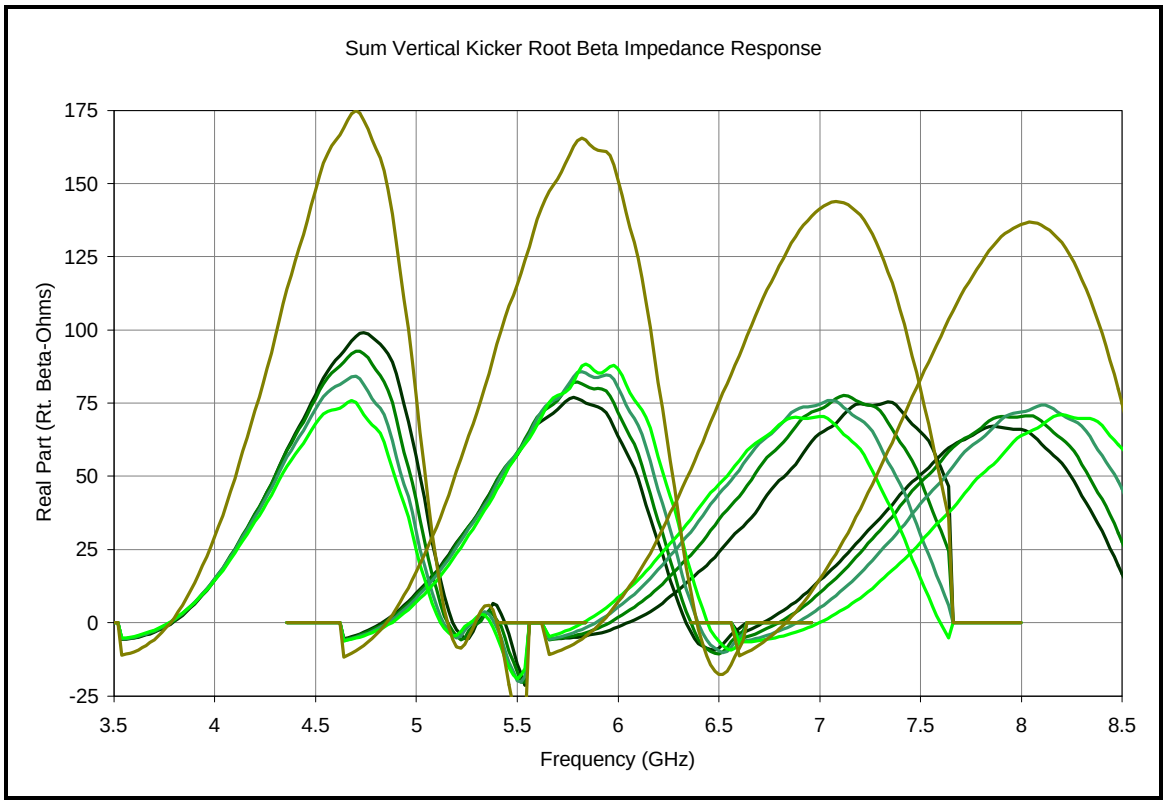

Difference Vertical Pickup Root Impedance Response
Real Part (Rt. Ohms)
20
15
10
5
0
-5
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)


Difference Vertical Pickup Transversal Filter
Real Part
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)


Sum Horizontal Kicker Root Beta Impedance Response
Real Part (Rt. Beta-Ohms)
175
150
125
100
75
50
25
0
-25
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)


Sum Horizontal Pickup Root Impedance Response
Real Part (Rt. Ohms)
160
140
120
100
80
60
40
20
0
-20
-40
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)


Sum Horizontal Pickup Transversal Filter
Real Part
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)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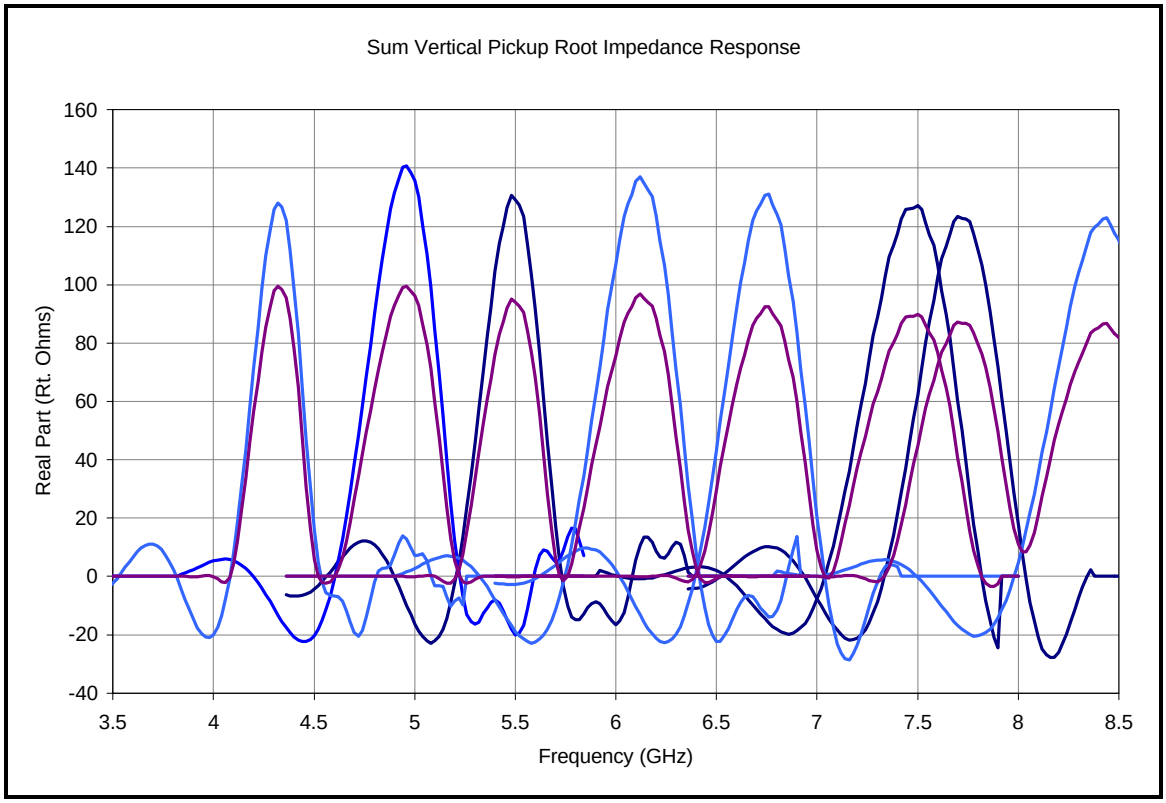
Real Part (Rt. Beta-Ohms)
175
150
125
100
75
50
25
0
-25
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
Frequency (GHz)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Real Part (Rt. Ohms)
160
140
120
100
80
60
40
20
0
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3.5
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5
5.5
6
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7
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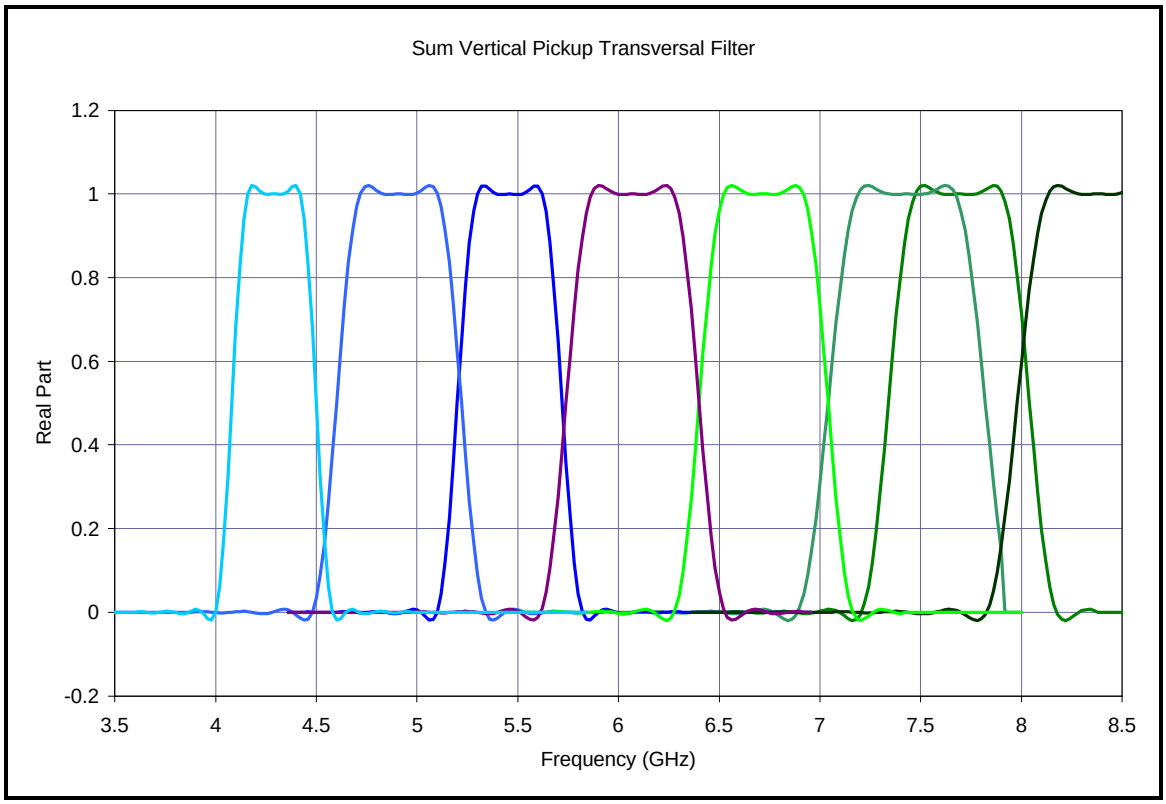

DEFINITION OF IMPEDANCES

TRANSVERSE

The old definition of the pickup impedance for the difference mode was:

$$P_{\Delta} = Z_{\Delta pu}\left(\frac{i_b}{2}\right)^2\left(\frac{y}{d/2}\right)^2 \qquad (1)$$

where P_{Δ} is the total power received from the pickup, i_b is the beam current, y is the distance between the beam and the mid-plane of the pickup and d is the transverse beam-pipe size.

The new definition of transverse pickup impedance is:

$$P_{\Delta} = \frac{1}{2}\left(Zn_{\Delta pu}\right)i_b{}^2\,\frac{\varepsilon_b}{1\pi - mm - mrad} \qquad (2)$$

where P_Δ is the total power received from the pickup, i_b is the beam current, ε_b is the un-normalized beam emittance. Note that $Zn_{\Delta pu}$ has units of Ohms. The relationship between the old impedance and the new impedance is:

$$Zn_{\Delta pu} = \frac{1}{2} Z_{\Delta pu} \frac{1\pi - mm - mrad}{\varepsilon_A} \tag{3}$$

where ε_A is the un-normalized acceptance of the beam pipe.

The old definition of the kicker impedance was:

$$P_\Delta = \frac{1}{2} \frac{\left(\frac{\Delta pc}{q}\right)^2}{Z_{\Delta kr}} \tag{4}$$

where P_Δ is the total power supplied to the kicker structure, Δpc is the change in transverse momentum, and q is the charge of the particle. The new definition of kicker impedance is:

$$P_\Delta = \frac{1}{2} \frac{\left(\sqrt{\beta_k}\,\frac{\Delta pc}{q}\right)^2}{Z\beta_{\Delta kr}} \tag{4}$$

where β_k is the beta function at the kicker. The relationship between the new and old kicker impedance is:

$$Z\beta_{\Delta kr} = \beta_k Z_{\Delta kr} \tag{5}$$

Note that $Z\beta_{\Delta kr}$ has unit of Ohms-meters.

LONGITUDINAL

The old longitudinal impedance for the pickup was given as:

$$P_\Sigma = Z_{\Sigma pu}\left(\frac{i_b}{2}\right)^2 \tag{6}$$

where P_Σ is the total power received from the pickup. The new definition is:

$$P_\Sigma = \frac{1}{2} Z_{\Sigma pu}^{new} {i_b}^2 \tag{7}$$

The relationship between the old and new definitions is:

$$Z_{\Sigma pu}^{new} = \frac{1}{2} Z_{\Sigma pu} \tag{8}$$

The definition of kicker impedance is unchanged:

$$P_{\Sigma} = \frac{1}{2} \frac{\left(\frac{\Delta pc}{q} \right)^2}{Z_{\Sigma kr}} \tag{9}$$

where P_{Σ} is the total power supplied to the kicker structure, Δpc is the change in longitudinal momentum, and q is the charge of the particle.