The order of diffraction, \( m \), is a parameter needed in the wavelength and Echelle "ripple" calibrations. It does not appear explicitly in the science data, so it must be calculated from parameters that are available. This report suggests an algorithm which uses the carrousel encoder position, and the digicon Y deflection to calculate the order number. These parameters are present in words 520 and 519 respectively of the HRS Science Data Engineering Trailer.

The carrousel calibration function is

\[
R = C - B \sin^{-1} \left( \frac{m\lambda}{A} \right)
\]  

(1)

when \( R = \) encoder position

\( A, B, C = \) constants stored in calibration data base.

The Y deflection calibration function is

\[
Y = a + b*\lambda + d*m\lambda
\]  

(2)

where \( Y = \) digicon Y deflection

\( a, b, d = \) constants stored in calibration data base.

Equations (1) and (2) can be solved for \( m \)

\[
m = \frac{bA \sin \left( \frac{C-R}{B} \right)}{Y-a-dA \sin \left( \frac{C-R}{B} \right)}
\]  

(3)
TABLE 1

Provisional calibration parameters based on ground based test data.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>EA</th>
<th>EB</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>7244</td>
<td>-3658</td>
</tr>
<tr>
<td>b</td>
<td>-4.644</td>
<td>1.854</td>
</tr>
<tr>
<td>d</td>
<td>0.01898</td>
<td>0.01701</td>
</tr>
<tr>
<td>A</td>
<td>62908</td>
<td>63212</td>
</tr>
<tr>
<td>B</td>
<td>182.044</td>
<td>182.044 *</td>
</tr>
<tr>
<td>C</td>
<td>39008</td>
<td>50596</td>
</tr>
</tbody>
</table>

* This value of B gives the argument of the sine function in degrees. To produce a value in radians use $B = 10430.38$.

Equation (3) will produce a real number within a few hundredths of the order number. Consequently

\[ \text{ORDER} = \text{FIX} (m + 0.2) \quad (4) \]