Wideband FSK Receiver

The MC13055 is intended for RF data link systems using carrier frequencies up to 40 MHz and FSK (frequency shift keying) data rates up to 2.0 M Baud (1.0 MHz). This design is similar to the MC3356, except that it does not include the oscillator/mixer. The IF bandwidth has been increased and the detector output has been revised to a balanced configuration. The received signal strength metering circuit has been retained, as has the versatile data slicer/comparator.

- Input Sensitivity 20 µV @ 40 MHz
- Signal Strength Indicator Linear Over 3 Decades
- Available in Surface Mount Package
- Easy Application, Few Peripheral Components

**Ordering Information**

<table>
<thead>
<tr>
<th>Device</th>
<th>Operating Temperature Range</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC13055D</td>
<td>$T_A = -40$ to $+85^\circ$C</td>
<td>SO–16 Plastic DIP</td>
</tr>
<tr>
<td>MC13055P</td>
<td></td>
<td>Plastic DIP</td>
</tr>
</tbody>
</table>

**Figure 1. Block Diagram and Application Circuit**

- Comparator Gnd
- Comparator VCC
- IF Ground
- IF VCC
- Limiter Input
- Limiter Bias
- Quad Bias
- Data Out
- Carrier Detect
- Meter Drive
- Detector Out
- Quad Input
- 40MHz IF Input (50Ω)
- 0.8V
- 0.01 µF
- 22pF
- 27pF
- 0.1 µF
- L1 22pF
- 0.01 µF
- 3.9k
- 39pF
- 0.8V
- 0.01 µF
# MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Voltage</td>
<td>VCC(max)</td>
<td>15</td>
<td>Vdc</td>
</tr>
<tr>
<td>Operating Supply Voltage Range</td>
<td>V2, V4</td>
<td>3.0 to 12</td>
<td>Vdc</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>T_J</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Ambient Temperature Range</td>
<td>T_A</td>
<td>–40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>T_stg</td>
<td>–65 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Power Dissipation, Package Rating</td>
<td>P_D</td>
<td>1.25</td>
<td>W</td>
</tr>
</tbody>
</table>

# ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0 \text{ Vdc}, f_0 = 40 \text{ MHz}, f_{mod} = 1.0 \text{ MHz}, \Delta f = \pm 1.0 \text{ MHz}, T_A = 25^\circ \text{C}, \text{ test circuit of Figure 2.})

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Drain Current</td>
<td>12 + 14</td>
<td>–</td>
<td>20</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Data Comparator Pull–Down Current</td>
<td>I_{16}</td>
<td>–</td>
<td>10</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td>Meter Drive Slope versus Input</td>
<td>I_{12}</td>
<td>4.5</td>
<td>7.0</td>
<td>9.0</td>
<td>\mu A/\text{dB}</td>
</tr>
<tr>
<td>Carrier Detect Pull–Down Current</td>
<td>I_{13}</td>
<td>–</td>
<td>1.3</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td>Carrier Detect Pull–Up Current</td>
<td>I_{13}</td>
<td>–</td>
<td>500</td>
<td>–</td>
<td>\mu A</td>
</tr>
<tr>
<td>Carrier Detect Threshold Voltage</td>
<td>V_{12}</td>
<td>690</td>
<td>800</td>
<td>1010</td>
<td>mV</td>
</tr>
<tr>
<td>DC Output Current</td>
<td>I_{10}, I_{11}</td>
<td>–</td>
<td>430</td>
<td>–</td>
<td>\mu A</td>
</tr>
<tr>
<td>Recovered Signal</td>
<td>V_{10} – V_{11}</td>
<td>–</td>
<td>350</td>
<td>–</td>
<td>mV rms</td>
</tr>
<tr>
<td>Sensitivity for 20 dB S + N/N, BW = 5.0 MHz</td>
<td>V_{IN}</td>
<td>–</td>
<td>20</td>
<td>–</td>
<td>\mu V rms</td>
</tr>
<tr>
<td>S + N/N at V_{IN} = 50 \mu V</td>
<td>V_{10} – V_{11}</td>
<td>–</td>
<td>30</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>Input Impedance @ 40 MHz</td>
<td>R_{in}, C_{in}</td>
<td>Pin 5, Ground</td>
<td>–</td>
<td>4.2</td>
<td>k\Omega</td>
</tr>
<tr>
<td>Quadrature Coil Loading</td>
<td>R_{in}, C_{in}</td>
<td>Pin 9 to 8</td>
<td>–</td>
<td>7.6</td>
<td>k\Omega</td>
</tr>
</tbody>
</table>

Figure 2. Test Circuit

- VCC
- Input 22pF 27pF 0.01 0.1
- L1 Gray 8–1/2 Turns, nominal 300 nH
- L2 Black 10–1/2 Turns, nominal 380 nH
- Carrier Detect Output
- Meter Drive
- Detector Output
- Coils – Shielded
  - Coilcraft UNI–10/142
  - L1 Gray 8–1/2 Turns, nominal 300 nH
  - L2 Black 10–1/2 Turns, nominal 380 nH

For More Information On This Product, Go to: www.freescale.com
Figure 3. Overall Gain, Noise, AM Rejection

Figure 4. Meter Current versus Signal

Figure 5. Untuned Input: Limiting Sensitivity versus Frequency

Figure 6. Untuned Input: Meter Current versus Frequency

Figure 7. Limiting Sensitivity and Detuning versus Supply Voltage

Figure 8. Detector Current and Power Supply Current versus Supply Voltage
Figure 9. Recovered Audio versus Temperature

Figure 10. Carrier Detect Threshold versus Temperature

Figure 11. Meter Current versus Temperature

Figure 12. Input Limiting versus Temperature

Figure 13. Input Impedance, Pin 5

\[ Y = 0.24 + 1.1 \]

\[ R_p = 4 \Omega \]

\[ C_p = 4 \mu \text{F} \]
Figure 14. Test Fixture
(Component Layout)

(Circuit Side View)
The MC13055 is an extended frequency range FM IF, quadrature detector, signal strength detector, and data shaper. It is intended primarily for FSK data systems. The design is very similar to MC3356 except that the oscillator/mixer has been removed, and the frequency capability of the IF has been raised about 2:1. The detector output configuration has been changed to a balanced, open-collector type to permit symmetrical drive of the data shaper (comparator). Meter drive and squelch features have been retained.

The limiting IF is a high frequency type, capable of being operated up to 100 MHz. It is expected to be used at 40 MHz in most cases. The quadrature detector is internally coupled to the IF, and a 2.0 pF quadrature capacitor is internally provided. The 20 dB quieting sensitivity is approximately 20 µV, tuned input, and the IF can accept signals up to 220 mVrms without distortion or change of detector quiescent DC level.

The IF is unusual in that each of the last 5 stages of the 6 stage limiter contains a signal strength sensitive, current sinking device. These are parallel connected and buffered to produce a signal strength meter drive which is fairly linear for input signals of 20 µV to 20 mVrms (see Figure 4).

A simple squelch arrangement is provided whereby the meter current flowing through the meter load resistance flips a comparator at about 0.8 Vdc above ground. The signal strength at which this occurs can be adjusted by changing the meter load resistor. The comparator (+) input and output are available to permit control of hysteresis. Good positive action can be obtained for IF input signals of above 20 µVrms. A resistor (R) from Pin 13 to Pin 12 will provide VCC/R of feedback current. This current can be correlated to an amount of signal strength hysteresis by using Figure 4.

The squelch is internally connected to the data shaper. Squelch causes the data shaper to produce a high (VCC) output.

The data shaper is a complete “floating” comparator, with diodes across its inputs. The outputs of the quadrature detector can be fed directly to either or preferably both inputs of the comparator to produce a squared output swinging from VCC to ground in inverted or noninverted form.