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# AN1658

# Converting MC13110/13111 Based Designs to the MC13110A,B/13111A,B

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## INTRODUCTION

The purpose of this application note is to provide the design engineer with information and techniques to modify existing MC13110/13111 Universal Cordless Telephone Subsystem IC designs to incorporate the MC13110A,B/13111A,B. The MC13110A,B/13111A,B is a pin compatible, improved 80% BiCMOS version of the MC13110/13111, with additional functionality and superior performance. Please refer to the MC13110A/D data sheet for additional information about the MC13110A,B/13111A,B.

## FIRST LOCAL OSCILLATOR

Figure 1 shows a typical varicap capacitance curve for both the MC13110/111 and MC13110A,B/13111A,B. As can be seen from these curves, the varicap of the MC13110A,B/13111A,B is about 1.4 pF higher than that of the MC13110/13111. As a result, either the external capacitance (preferred) or inductance of the local oscillator should be reduced.

Both the MC13110/13111 and MC13110A,B/13111A,B incorporate internal, user selected capacitors that can be used to extend the adjustable first local oscillator frequency range. As shown in Table 1, there is a negligible difference between capacitor select numbers 0–5. For applications where capacitor select numbers 6 and 7 are being used on the MC13110/13111, it is suggested that these be re–mapped to MC13110A,B/13111A,B capacitor select numbers 4 and 8, respectively.

**Figure 1.**

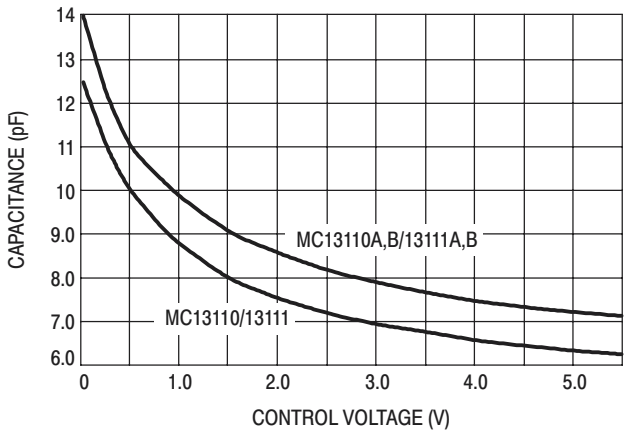

Table 1.

| Capacitor Select Number | MC13110/13111 Capacitor Value (pF) | MC13110A,B/13111A,B Capacitor Value (pF) |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 1.5 | 1.7 |
| 2 | 0.8 | 0.6 |
| 3 | 7.1 | 7.1 |
| 4 | 5.7 | 6.0 |
| 5 | 2.3 | 2.8 |
| 6 | 6.5 | 3.9 |
| 7 | 7.9 | 4.9 |
| 8 | – | 8.2 |
| 9 | – | 9.4 |
| 10 | – | 10.5 |
| 11 | – | 11.6 |
| 12 | – | 12.7 |
| 13 | – | 13.8 |
| 14 | – | 14.9 |
| 15 | – | 16.0 |



## FIRST MIXER

The first mixer of the MC13110A,B/13111A,B has improved performance for conversion gain, 1.0 dB compression and IP3 level over the MC13110/13111. In addition, the MC13110A,B/13111A,B has a programmable “IP3 increase” bit, which further improves the 1.0 dB compression point and IP3 level. As a result, no modifications should be required to the first mixer with respect to these parameters, regardless of the setting of the IP3 increase bit.

The first mixer differential input impedance for both the MC13110/13111 and MC13110/13111 remain essentially the same. However, the single ended impedance of the MC13110/13111 is now approximately 1600 Ω || 3.7 pF, while the single ended input impedance of the MC13110/13111 is approximately 800 Ω || 3.2 pF. As a result, single–ended mixer driving applications may require some modifications to insure optimum impedance matching.

The output impedance of the first mixer for the MC13110A,B/13111A,B has decreased to approximately 300 Ω || 3.7 pF as compared to the MC13110/13111 395 Ω || 3.2 pF. For most applications using a external, 330 Ω ceramic bandpass filter, no modifications should be necessary (due to the relatively wide bandwidth of the ceramic element). For applications that use a crystal filter, these changes become important. However, since most crystal applications use an external resistor to match the impedance, the only change which should be required would be the value of the external resistor itself.

## SECOND MIXER

The second mixer of the MC13110A,B/13111A,B has significantly improved performance for conversion gain, 1.0 dB compression and IP3 level over the MC13110/13111. As a result, no modifications should be required to the second mixer with respect to these parameters, regardless of the setting of the IP3 increase bit.

The second mixer input impedance for both the MC13110/13111 and MC13110/13111 remain essentially the same (approximately 2850 Ω || 3.6 pF), and no modifications (for ceramic or crystal bandpass filters) should be required. Additionally, the second mixer output impedance for both the MC13110/13111 and MC13110A,B/13111A,B are not changed, so no modifications should be required for the second bandpass filter.

## IF AMPLIFIER, LIMITER, RSSI, DETECTOR, and RECEIVE AUDIO

The receive gain adjust range for the MC13110A,B/13111A,B is from –9.0 dB to 10 dB, while the MC13110/13111 range is from –15 dB to 16 dB. Since the registers are compatible, this should not pose any significant problems. The reduced range has proved to be adequate for normal applications.

The remainder of these sections remain essentially unchanged and no external modifications should be required.

## DATA AMPLIFIER

The data amplifier input impedance of the MC13110A,B/13111A,B has been increased to 240 kΩ (from a nominal 11 kΩ for the MC13110/13111), making it much easier to implement an external bandpass filter. For most applications, this increased input impedance should not require modifications.

## TRANSMIT AUDIO PATH

The maximum output swing capability of the MC13110A,B/13111A,B is about 4.0 dB less than the

MC13110/13111. For most applications, this is more than sufficient to drive an external transmit $V_{CO}$. If this does become a problem, it will be necessary to modify the external $V_{CO}$ to increase the radial gain constant.

The transmit gain adjust range for the MC13110A,B/13111A,B is from –9.0 dB to 10 dB, while the MC13110/13111 range is from –15 dB to 16 dB. Since the registers are compatible, this should not pose any significant problems. The reduced range has proved to be adequate for normal applications.

## SECOND LOCAL OSCILLATOR

The second local oscillator of MC13110A,B/13111A,B exhibits about 6.0 dB higher gain than that of the MC13110/13111. This allows the user to specify higher capacitance crystals. Additionally, the start up time for a given crystal will usually be reduced by a factor of two or more.

The input/output capacitance of the MC13110A,B/13111A,B second local oscillator is typically 2.9/2.7 pF, whereas the MC13110/13111 is 4.1/5.3 pF, respectively. As a result, the second local oscillator frequency for the MC13110A,B/13111A,B will be slightly higher. It will probably be necessary to modify the external load capacitors to re–align the frequency to its desired center.

## OTHER PARAMETERS

The 12 dB SINAD receiver sensitivity of the MC13110A,B/13111A,B has been improved about 3.0 dB.

The active mode maximum $I_{CC}$ has been decreased from 12 mA for the MC13110/13111 to 10.5 mA for the MC13110A,B/13111A,B. The inactive mode maximum $I_{CC}$ has also been decreased from 80 μA for the MC13110/13111 to 30 μA for the MC13110A,B/13111A,B.

The standby mode maximum $I_{CC}$ has been increased from 500 μA for the MC13110/13111 to 560 μA for the MC13110A,B/13111A,B.

## SUMMARY

Modifying existing MC13110/13111 designs to incorporate the newer MC13110A,B/13111A,B will usually require only a few minor changes in already existing external component values. The possibility exists that minor changes may be required to software, but this is unlikely. Most systems will experience improved performance for battery life and range.

## ACKNOWLEDGMENTS

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