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MOTOROLA

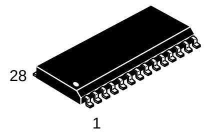
MC13030

Advance Information

Dual Conversion AM Receiver

DUAL CONVERSION AM RECEIVER

SEMICONDUCTOR TECHNICAL DATA



DW SUFFIX
PLASTIC PACKAGE
CASE 751F

The MC13030 is a dual conversion AM receiver designed for car radio applications. It includes a high dynamic range first mixer, local oscillator, second mixer and second oscillator, and a high gain AGC'd IF and detector. Also included is a signal strength output, two delayed RF AGC outputs for a cascode FET/bipolar RF amplifier and diode attenuator, a buffered IF output stage and a first local oscillator output buffer for driving a synthesizer. Frequency range of the first mixer and oscillator is 100 kHz to 50 MHz.

Applications include single band and multi–band car radio receivers, and shortwave receivers.

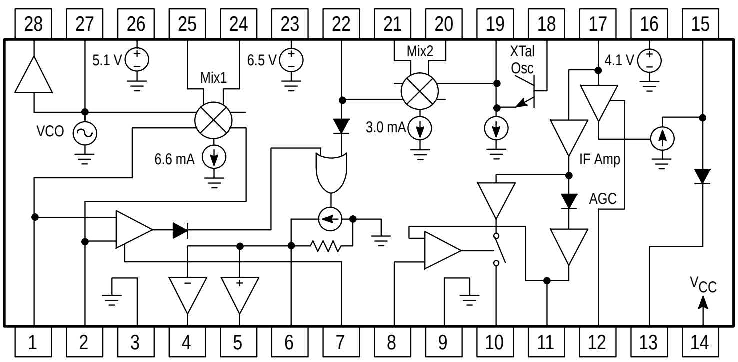
- Operation from 7.5 to 9.0 Vdc
- First Mixer, 3rd Order Intercept = 20 dBm
- Buffered First Oscillator Output
- Second Mixer, 3rd Order Intercept = +5.0 dBm
- No Internal Beats Between 1st and 2nd Oscillator Harmonics
- Signal Strength Output
- Limited 2nd IF Output for Frequency Counter Station Detector
- Adjustable IF Output Station Detector Level
- Adjustable RF AGC Threshold for Both Mixer Inputs
- Two Delayed AGC Outputs for Cascode RF Stage and Diode Attenuator

PIN CONNECTIONS

1	Mix1 In	VCO Out	28
2	Mix1 In	VCO	27
3	RF Gnd	VCO Ref	26
4	FET RF AGC	Mix1 Out	25
5	RF AGC2	Mix1 Out	24
6	RF AGC Adj	V_{ref}	23
7	Mix1 RF AGC Adj	Mix2 In	22
8	SD Level	Mix2 Out	21
9	IF Gnd	Mix2 Out	20
10	SD IF Out	Xtal Osc E	19
11	S Level Out	Xtal Osc B	18
12	IF AGC In	IF In	17
13	AF Out	Det V_{ref}	16
14	V_{CC}	Det In	15

(Top View)

Representative Block Diagram



This device contains 335 active transistors.

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC13030DW	T_A = –40° to +85°C	SOIC–28

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Rev 1

MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted.)

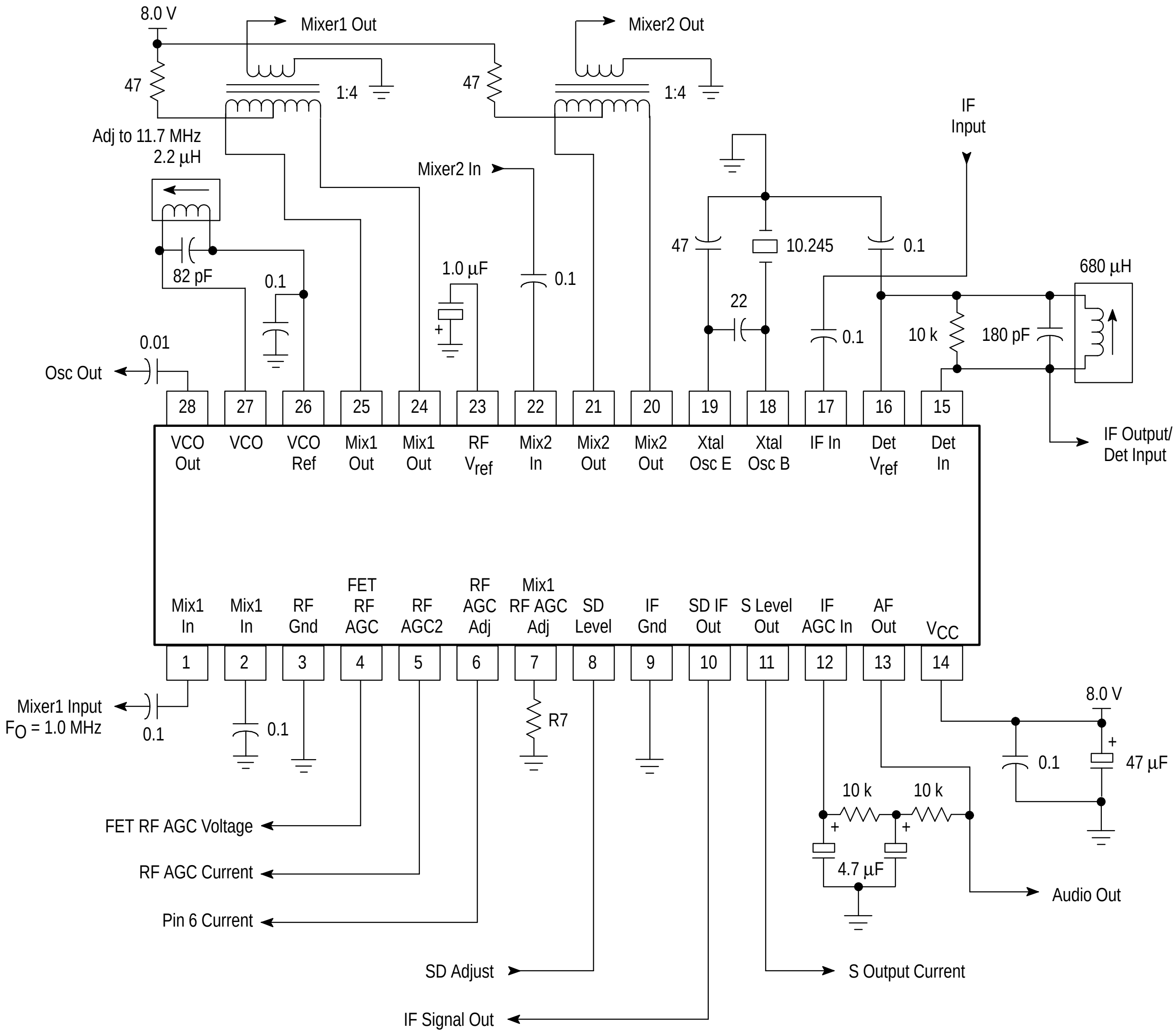
Rating	Symbol	Value	Unit
Power Supply	V_{CC}	10	V
Operating Temperature	T_A	–40 to +85	°C
Storage Temperature	T_{stg}	–65 to +150	°C
Junction Temperature	T_J	150	°C

NOTE: ESD data available upon request.

ELECTRICAL CHARACTERISTICS (T_A = 25°C, V_{CC} = 8.0 V, unless otherwise noted.)

Characteristic	Condition/Pin	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	–	V_{CC}	7.5	8.0	9.0	V
Power Supply Current	V_{CC} = 8.0 V	I_{CC}	26	32	44	mA
Detector Output Level	V_{in} = 1.0 mV, 30% Mod.	V13	160	200	240	mVrms
Audio S/N Ratio	V_{in} = 1.0 mV, 30% Mod.	S/N	48	52	–	dB
Audio THD	V_{in} = 1.0 mV, 30% Mod. V_{in} = 1.0 mV, 80% Mod. V_{in} = 2.0 mV, 80% Mod.	THD	– – –	0.3 0.3 0.4	1.0 1.0 1.5	%
Signal Strength Output	V_{in} = 0 to 2.0 V	V11	0	–	5.2	V
VCO Buffer Output	–	V28	178	224	282	mV
SD Output Level	V_{in} = 1.0 mV, V11 > V8	V10	2.3	2.7	3.3	Vpp
MIXER1						
Input Resistance	1 or 2 to Gnd	–	–	10	–	kΩ
Third Order Intercept Point	1 or 2	IP3	–	127	–	dBμV
Conversion Transconductance	1 or 2 to 24 + 25	g_c	–	2.2	–	mS
Total Collector Current	24 + 25	I_C	–	4.6	–	mA
Input IF Rejection	1 or 2	–	–	45	–	dB
MIXER2						
Input Resistance	22	–	–	2.4	–	kΩ
Third Order Intercept Point	22	IP3	–	112	–	dBμV
Conversion Transconductance	22 to 20 + 21	g_c	–	4.6	–	mS
Total Collector Current	20 + 21	I_C	–	3.0	–	mA
VCO						
Minimum Oscillator Coil Parallel Impedance	27 to 26	R_P	–	3.0	–	kΩ
Buffer Output Level	28	V_O	–	224	–	mVrms
Stray Capacitance	27	C_S	–	7.0	–	pF
IF AMPLIFIER						
Input Resistance	17	R_{in}	–	2.0	–	kΩ
Transconductance	17 to 15	g_m	–	28	–	mS
Maximum Input Level	17	V_{in}	–	125	–	mVrms
Minimum Detector Coil Parallel Impedance	17 to 15	R_L	–	15	–	kΩ
RF Output Level	15, V_{in} = 1.0 mV	–	–	2.0	–	Vpp
Audio Output Impedance	13	R_{out}	–	120	–	Ω
Audio Output Level	13 @ 30% Mod.	V_{out}	–	200	–	mVrms

Figure 1. Test Circuit



NOTES:
1. The transformers used for at the output of the mixers are wideband 1:4 impedance ratio. The secondary load is the 50 Ω input of the spectrum analyzer, so the impedance across the collectors of the mixer output is 200 Ω.
2. Since the VCO frequency is not critical for this measurement, a fixed tuned oscillator tuned to 11.7 MHz is used. This gives an input frequency of 1.0 MHz.
3. The detector coil is loaded with a 10 k resistor to reduce the tuned circuit Q and to present a 10 kΩ load to the IF output for determination of IF transconductance.
4. The RF AGC current, S output current and Pin 6 current are measured by connecting a current measuring meter to these pins, so they are effectively shorted to ground.
5. SD adjust is adjusted by connecting a power supply or potentiometer and voltmeter to Pin 8.

FUNCTIONAL DESCRIPTION

The MC13030 contains all the necessary active circuits for an AM car radio or shortwave receiver.

The first mixer is a multiplier with emitter resistors in the lower, signal input transistors to give a high dynamic range. It is internally connected to the first oscillator (VCO). The input pins are 1 and 2. The input can be to either Pins 1 or 2, or balanced. These pins are internally biased, so a dc path between them is allowable but not necessary. The mixer outputs are open collectors on Pins 25 and 26. They are normally connected to a tuned transformer.

The first oscillator on Pin 27 is a negative resistance type with automatic level control. The level is low so the signal does not modulate the tuning diode capacitance and cause distortion. Pin 26 is the reference voltage for the oscillator coil. This reference is also the supply for the mixer circuits. The upper bases of the mixer are 0.7 V below this reference.

The second mixer is similar to the first, but it is single–ended input on Pin 22. Its outputs are open collectors on Pins 20 and 21 which are connected to a tuned transformer. The dynamic range of this mixer is less than the first. It is also connected internally to an oscillator which is normally crystal controlled. The oscillator is a standard Colpitts type with the emitter on Pin 19 and the base on Pin 18.

The IF amplifier input is Pin 17. The AGC operates on the input stage to obtain maximum dynamic range and minimum distortion. The IF output, Pin 15, is a current source.

Therefore, its gain is determined by the load impedance connected between Pins 15 and 16. Pin 16 is a voltage reference for the output. The output is internally connected to the AM detector, and Pin 13 is the detector output. This detector also provides the AGC signal for the IF amplifier. An RC filter from Pin 13 to 12 removes the audio, leaving a dc level proportional to the carrier level for AGC.

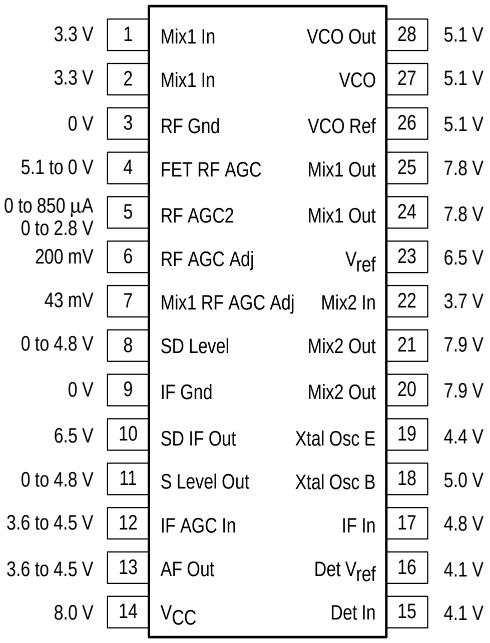
Pin 11 provides a current proportional to signal strength. It is a current source so a resistor must be connected from Pin 11 to ground to select the desired dc voltage range. The current is proportional to the signal level at Pin 17, the IF amplifier input.

A high–gain limiting amplifier is used to derive the station detect (SD) signal output on Pin 10; this output is present only if it is turned on by the voltage on Pin 8. If the voltage on Pin 8 is less than the voltage on Pin 11, the output on Pin 10 is "on". The station detector IF output on Pin 10 is used with synthesizers which have a frequency counting signal detector.

The RF AGC outputs on Pins 4 and 5 are controlled by the signal levels at Mixer1 or Mixer2. Bypass capacitors are required on Pins 6 and 4 to remove audio signals from the AGC outputs. Pin 4 is designed to control the NPN transistor in series with the RF amplifier FET. The voltage on Pin 4 is 5.1 V with no input signal and decreases with increasing input signal. Pin 5 is designed to control an additional AGC circuit at the antenna input. The voltage on Pin 5 is at 0 V with no input signal and increases with increasing input signals. The voltage on Pin 5 does not increase until the voltage on Pin 4 has decreased to about 1.3 V. In most cases, Pin 5 is used to drive a diode shunt. Maximum output current is about 850 µA.

The RF AGC sensitivity is about 40 mVrms input to Mixer1 or about 2.0 mVrms input to Mixer2 at 1.0 MHz. The AGC sensitivity for both mixers can be decreased by adding a resistor from Pin 6 to ground. There is also an additional amplifier between Mixer1 and its AGC rectifier. The gain of this amplifier and AGC sensitivity for Mixer1 can be increased by adding a resistor from Pin 7 to ground. Therefore, the desired AGC sensitivity for both mixers can be achieved by changing the resistors on Pins 6 and 7.

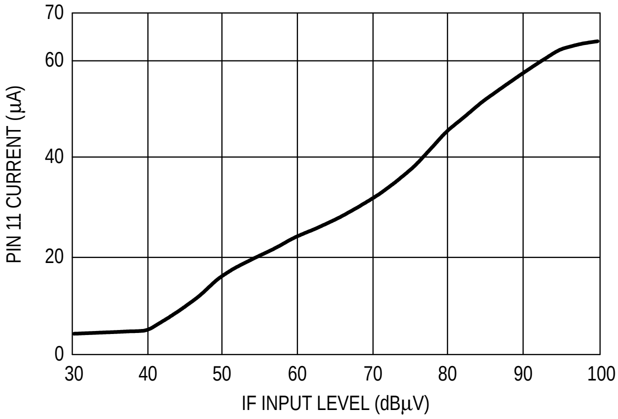
Figure 2. Pin Connections and DC Voltages



S Out versus IF Input:

The S output current at Pin 11 is provided by two collectors, one a PNP source and the other a sink to ground. The desired S output voltage can be selected using the curve of Figure 3 and calculating the value of the required resistor.

Figure 3. S Output Current versus IF Input Level



RF FET AGC versus Mixer1 and Mixer2 Input Level:

Figures 4 and 5 are generated with no external resistance on Pins 4 or 6, so they represent the minimum RF AGC sensitivity of Mixer1 and Mixer2.

Figure 4. RF AGC Voltage versus Mixer1 Input

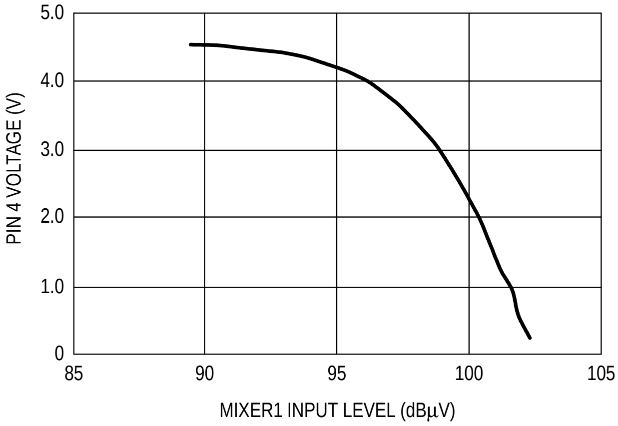
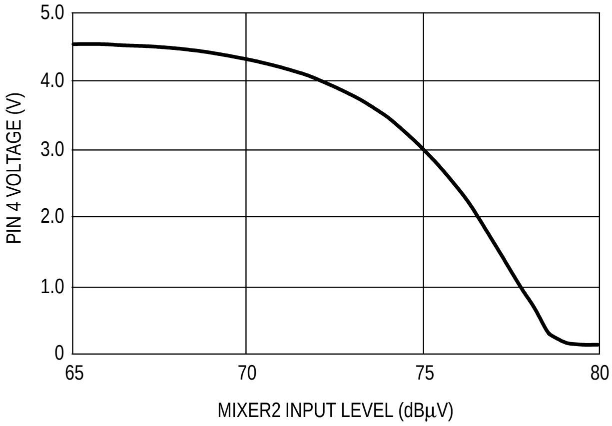


Figure 5. RF AGC Voltage versus Mixer2 Input



Pin 6 Current versus Mixer1 and Mixer2 Input Level:

The internal resistance from Pin 6 to ground is 39 k. The RF AGC voltage on Pin 4 is 2.0 V when the voltage on Pin 6 is 1.2 V. Therefore, the desired AGC thresholds for either mixer can be set with these curves. The design steps are described in the design notes.

Figure 6. Pin 6 Current versus Mixer1 Input Level

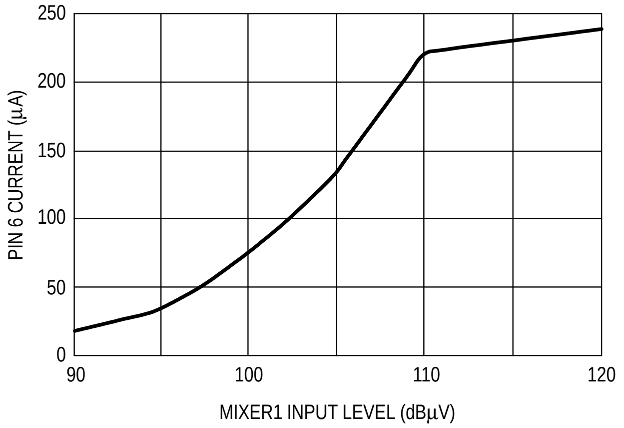
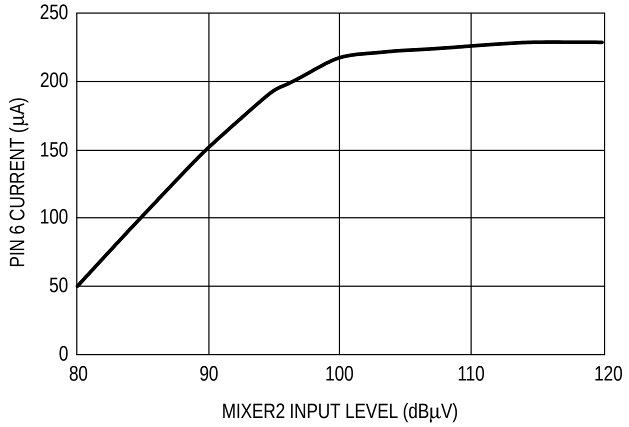


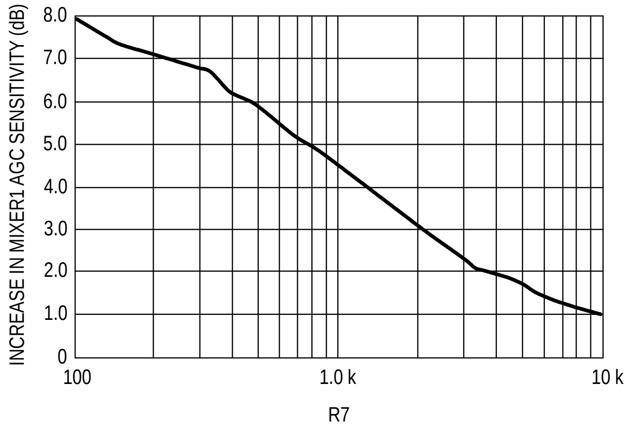
Figure 7. Pin 6 Current versus Mixer2 Input Level



Mixer1 AGC Gain Increase versus R7:

Adding a resistor from Pin 7 to ground increases the AGC sensitivity of Mixer1. The range of increase in dB can be found from this curve. This is useful after setting up the AGC threshold of Mixer2.

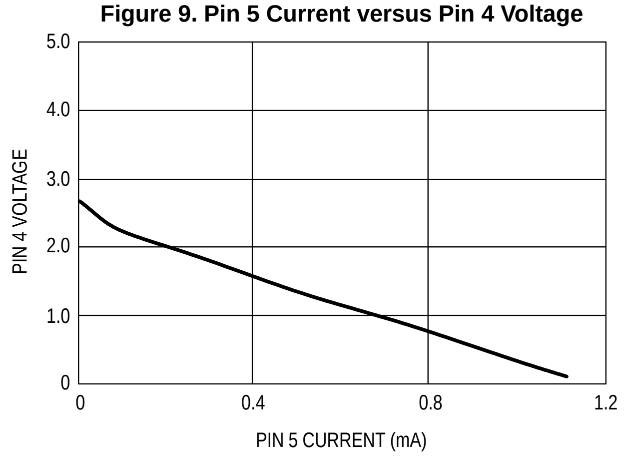
Figure 8. Mixer1 AGC Gain Increase versus R7



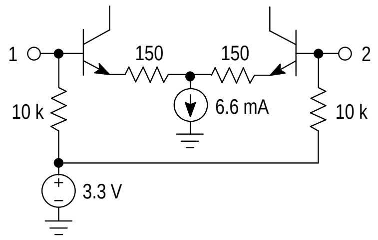
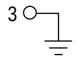
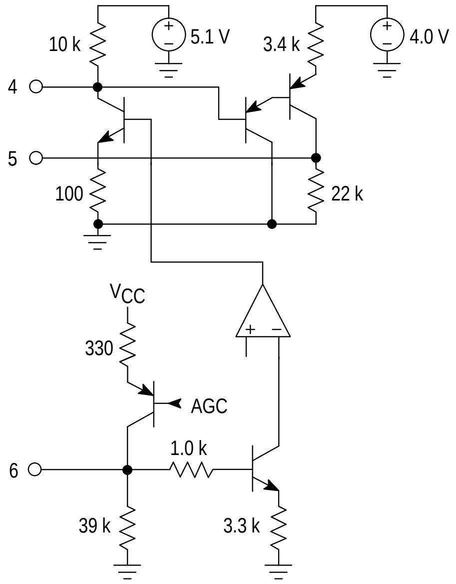
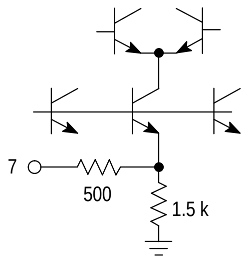
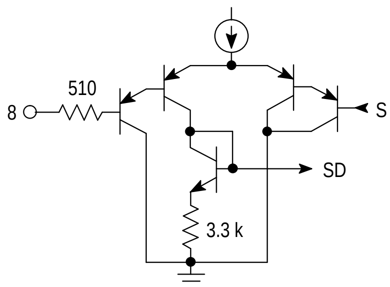
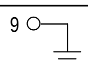
Pin 5 Current versus Pin 4 Voltage:

All the curves give Pin 4 AGC voltage versus some other input level. This curve can be used to determine the auxiliary AGC current from Pin 5 at a given Pin 4 voltage.

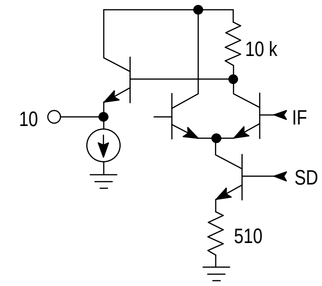
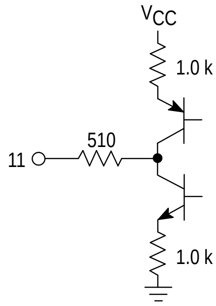
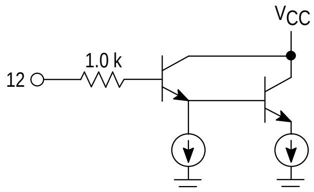
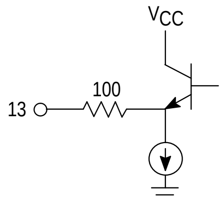
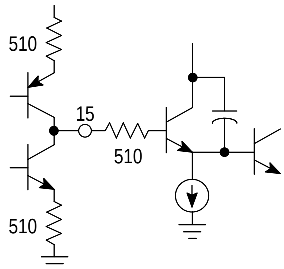
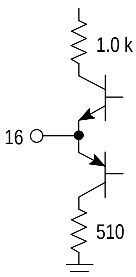
Figure 9. Pin 5 Current versus Pin 4 Voltage



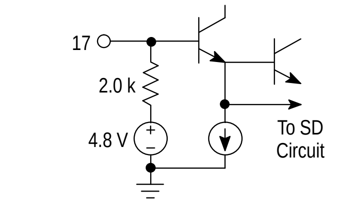
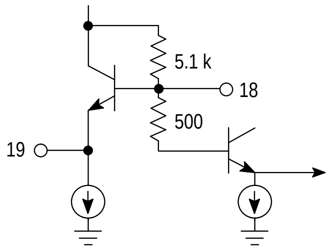
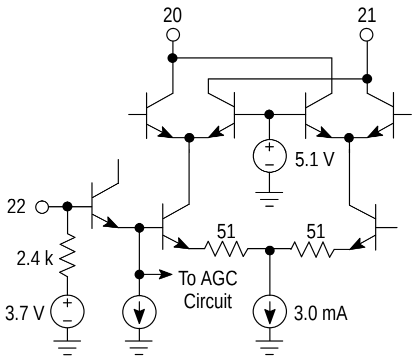
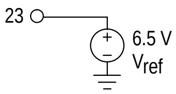
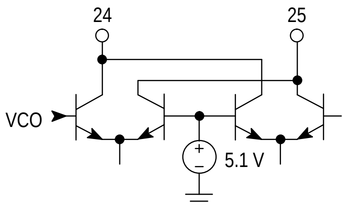
PIN FUNCTION DESCRIPTION

Pin No.	Internal Equivalent Circuit	Description
1, 2		**Mixer1 Input** Pins 1 and 2 are equivalent. In the application circuit, 2 is grounded with a capacitor and 1 is the input. If a load resistor is needed for the input filter, it can be placed across Pins 1 and 2. Input impedance for each pin is 10 k. IP3 (third order intercept) at the input is 20 dBm (127 dBμ). To guarantee –50 dB IM3, the input level should not be greater than 3.5 dBm (103 dBμ) (150 mVrms).
3		**RF Ground** This should be connected to the ground used for the RF circuits.
4		**FET RF AGC Output** This is the AGC for the cascode transistor connected to the RF amplifier FET. The no–signal voltage is 5.1 V. The voltage decreases with increasing input signals. A bypass capacitor and electrolytic capacitor must be added to filter out RF signals on the transistor and audio signals in the AGC signal. See Figures 4 and 5.
5		**RF AGC2 Output** The voltage on this pin starts at 0 and increases with increasing input signals. It is normally used to turn on diodes or a transistor connected across the antenna input and is AGC delayed until Pin 6 reaches 2.7 V. If the voltage on Pin 5 decreases below 2.0 V, the voltage on this pin will decrease from 3.1 down to about 1.5 V. The maximum output current is about 850 μA.
6		**RF AGC Adjust** An electrolytic capacitor of 1.0 μF must be connected to prevent audio modulation of the AGC circuits. If there is no resistor on this pin, the RF AGC starts at an input level to Mixer1 ≈ 40 mVrms or Mixer2 ≈ 2.0 mVrms. Connecting a resistor from Pin 6 to ground increases RF levels required for AGC to start. It should be used to set the desired AGC level of Mixer2. If a resistor is not connected to Pin 6, unwanted RF signals will cause the AGC to start at a very low level, and desired signals may be suppressed.
7		**Mixer1 RF Level Adjust** A resistor from Pin 7 to ground will increase the gain of an amplifier from the input of Mixer1 to the AGC circuit. It can be used to set the RF AGC level of Mixer1. The minimum value of R7 is about 680 Ω.
8		**Station Detector Signal Level Adjust** A voltage on Pin 8 will set the desired signal strength at which the SD IF Out on Pin 10 appears. The other input to this comparator is the S (signal strength) signal. If Pin 8 is grounded, a square wave of the 2nd IF (usually 450 of 455 kHz) is present with very small input levels. This output could also be used to drive an FM detector if desired.
9		**IF Ground** Pin 9 is the ground for the IF section.

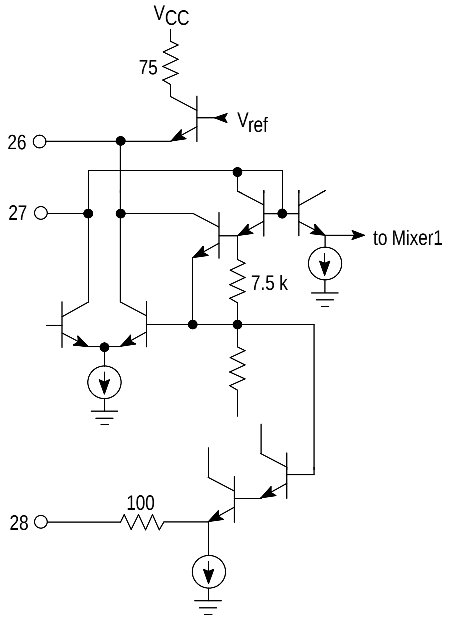
PIN FUNCTION DESCRIPTION (continued)

Pin No.	Internal Equivalent Circuit	Description
10		**Station Detector IF Output** This output is "on" when V11 > V8. The output is an amplified and limited 2nd IF signal. The signal level is ≈ 250 mVpp when it is 100% "on".
11		**S Level Output** This is a dc current proportional to IF input level. With a load resistor of 75 k, the dc voltage is 0 to 5.1 V.
12		**IF AGC In** The IF gain is controlled by the dc voltage on this pin. It is normally connected to Pin 13 through an RC network to filter out the audio signal on Pin 13. The IF gain is maximum when V13 ≈ 3.6 V. When V13 increases, the IF gain decreases.
13		**Audio Output** The dc voltage on Pin 13 is ≈ 3.6 V with no input signal and increases to ≈ 4.5 V at minimum IF gain. A nonpolarized electrolytic capacitor may be required to couple to the audio circuits if the audio amplifier dc bias voltage is between these voltages.
14	14 ○⟶ V_{CC}	**Supply Voltage** The nominal operating voltage is 8.0 V.
15		**IF Amplifier Output and Detector Input** The detector coil must be connected between Pin 15 and 16. The IF amplifier output is a current source, the IF amplifier is a transconductance amplifier; the gain is determined by the impedance between Pins 15 and 16. The IF amplifier g_m ≈ 0.028 mho. If a wide bandwidth IF is desired, the detector coil can be connected between Pins 15 and 16 without a tap and then loaded with a resistor across the coil.
16		**Detector Reference Voltage** One side of the detector coil is connected to this pin. It should be bypassed with a 0.1 µF capacitor.

PIN FUNCTION DESCRIPTION (continued)

Pin No.	Internal Equivalent Circuit	Description
17		**IF Input** The IF input impedance is 2.0 k to match most ceramic 455 or 450 kHz filters. For a ceramic filter requiring a 1.5 k load, a 5.6 k resistor in series with a 0.01 μF capacitor should be connected from Pin 17 to ground.
18		**Crystal Oscillator Base** The crystal oscillator is a simple Colpitts type, operating at a low current. The crystal should operate at 10.250 MHz for 450 kHz IF or 10.245 MHz for 455 kHz IF with a 20 pF load capacitance. The oscillator signal to the second mixer is coupled from Pin 18 through an emitter follower. If a synthesizer such as the Motorola MC145170 with a 15 bit programmable R counter is used, the 10.245 MHz crystal can be connected to the synthesizer, and a 200 mVpp oscillator signal from the synthesizer can be capacitively coupled to Pin 18, so only one crystal is needed.
19		**Crystal Oscillator Emitter** The capacitive divider from Pin 18 is connected as shown in the application circuits of Figures 10, 11, 12.
20, 21		**Mixer2 Output** The maximum AC collector voltage is about 5.8 Vpp or 2.0 Vrms. The mixer conversion transconductance g_C = 0.0046 mho. The load impedance should be selected so the mixer output does not overload before the input.
22		**Mixer2 Input** The input impedance is 2.4 k. A series R–C network from Pin 22 to ground or a resistor from the filter to Pin 22 can be used to properly match the filter. In most cases, a 10.7 MHz crystal filter can be connected to Pin 22 directly without any additional components. IP3 (third order intercept) at the input is 5.0 dBm (112 dBμ). To guarantee –50 dB IM3, the input level should not be greater than –20 dBm (87 dBμ) (22.7 mVrms).
23		**V_{ref}** This is the main reference voltage for most of the circuits in the IC and should be bypassed with a 1.0 μF capacitor.
24, 25		**Mixer1 Output** The maximum collector voltage is about 5.8 Vpp or 2.0 Vrms. The mixer conversion transconductance g_C = 0.0022. The load impedance should be selected so the mixer output does not overload before the input.

PIN FUNCTION DESCRIPTION (continued)

Pin No.	Internal Equivalent Circuit	Description
26		**VCO Reference** The first oscillator coil is connected from Pin 26 to 27. Pin 26 must be bypassed to ground with a capacitor which has a low impedance at the oscillator frequency. This capacitor also will reduce the phase noise of the VCO.
27		**VCO** The VCO is a negative resistance type and has an internal level control circuit so a tapped coil or one with a secondary is not needed. The level is fixed at 0.8 Vpp so the oscillator signal does not modulate the tuning diode, thus keeping the distortion low. The oscillator stray capacitance is ≈ 12 pF and the tuned circuit impedance should be greater than 3.0 k to guarantee oscillation. Oscillator range is up to 45 MHz so it can be used for SW receivers.
28		**VCO Out** The output level is 240 mVrms (108 dBμ), high enough to drive any CMOS synthesizer.

AM CAR RADIO DESIGN NOTES

The MC13030 AM Radio IC is intended for dual conversion AM radios. In most cases, the 1st IF frequency (F_{IF1}) is upconverted above the highest input frequency. The first oscillator (VCO) is tuned by a synthesizer and operates at F_{in} + F_{IF1}. For the 530 to 1700 kHz AM band with a 10.7 MHz first IF, the VCO goes from 11.23 to 12.40 MHz. Therefore, F_{max}/F_{min} for VCO is only 1.104, so one low–cost tuning diode can be used. Since the required tuning voltage range can be made less than 5.0 V, it may also be possible to drive the tuning diode directly or from the phase detector of the synthesizer IC, such as the Motorola MC145170, operating from 5.0 V, without using a buffer amplifier or transistor.

If the VCO is above the incoming frequency, the image frequency of the first mixer is at f_{OSC} + F_{IF1}. For the AM broadcast receiver, it is around 22 MHz, so a simple LPF can be used between the RF stage and Mixer1 input. However, if a LPF is used, an additional coil is still needed to supply the collector voltage of the RF amplifier. For this reason, a BPF filter was used in the application circuit instead, since it uses the same number of coils and gives better performance. It is simply a lowpass to bandpass conversion. The lowpass filter is designed to have a cutoff frequency equal to the desired bandwidth. In this case, it would be 1700 – 530 kHz = 1170 kHz. Then, it is transformed to be resonant at 949 kHz, the geometric mean of the end frequencies: $\sqrt{1700 \times 530}$ = 949 kHz.

A balanced–to–unbalanced transformer is required at the output of both mixers. The first one is designed so that Mixer1 has enough gain to overcome the loss of the 10.7 MHz filter and so that the output of the mixer will not overload before the input. The primary impedance of the transformer is relatively low, and it may be difficult to control with commonly available 7.0 mm transformers because the number of primary turns is quite small. It would also require a large tuning capacitance. A better solution is to tune the secondary with a small capacitance and then use a capacitive divider to match the tuned circuit to the filter. This allows one transformer to be used for either a ceramic or crystal filter. The capacitors can be adjusted to match the filter. The recommended coil is made this way.

If the formula: P_{in} = IP3 – DR/2 is used, the maximum input level to the mixer can be calculated for a desired dynamic range.

IP3 = 3rd order intercept level in dB (dBm or dBμ)

DR = dynamic range in dB between the desired signals and 3rd order intermodulation products

P_{in} = input level in dBm or dBμ

The RF AGC level can then be adjusted so that P_{in} does not exceed this level.

Whether or not a narrow bandwidth crystal or wide bandwidth ceramic filter is used between the first and second mixers depends on the receiver requirements. It is possible to achieve about 50 dB adjacent channel and IM rejection with a ceramic filter because of the wide dynamic range of the mixers. If more than this is required, a crystal filter should be used. If a crystal filter is used, a lower cost CFU type of 455 kHz second IF filter can be used. If a ceramic filter is used, a CFW type filter should be used because there is no RF section selectivity in this type of radio.

Since the wideband AGC system is quite sensitive, it can be set to eliminate all spurious responses present at the receiver output. However, the RF AGC will sometimes eliminate or reduce the level of desired signals if there is a strong signal somewhere in the bandpass of the RF circuit.

The second mixer is designed like the first and requires a balanced output. Since its load impedance is higher, the transformer can be designed to be tuned on the primary or secondary, but, like with the one for the first mixer, if the secondary is tuned, the tap can be adjusted for the impedance of the 455 kHz filter. Wideband filters usually have a higher terminating resistance than the narrowband ones. The recommended coil is made this way.

The IF amplifier is basically a transconductance amplifier because the output is a current source. The output is also internally connected to a high impedance AM detector. g_m for the IF amplifier is ≈ 0.028 mho. The voltage gain will be the detector coil impedance x 0.028. This can be designed to give the desired audio output level for a given RF input level. If it is set too high, the receiver may oscillate with no input signal. The application circuit was designed for a relatively narrow bandwidth, so a tapped detector coil is used to get the desired gain. If a wide bandwidth receiver is desired, the detector coil can be untapped, and a resistor can be added across the coil to get the desired Q.

The detector output on Pin 13 is a low impedance. It supplies the IF AGC signal to Pin 12, so the audio must be filtered out. The time constant of this filter is up to the designer. The main requirement is usually the allowable audio distortion at 100 Hz, 80% modulation. If the time constant is made too long, the audio level will be slow to correct when changing stations.

The Signal Strength (S) output is dependent only on the IF amplifier input level. Its maximum voltage is about 5.0 V with a 75 k load resistor. The range can be reduced by using a lower value for the resistor on Pin 11. The S signal will stop increasing when the RF AGC circuits become active, so if the RF AGC threshold is set too low, or there is too much loss from the Mixer2 output to the IF input, the maximum S signal will be reduced. The desired load resistor on Pin 11 (R11) can be determined using the curve of Pin 11 current versus IF input.

Setting the RF AGC threshold is probably the most difficult because a trade–off between allowable interference and suppression of desired signals must be made.

First select the values for both mixers:

a. Using the formula P_{in} = IP3 – DR/2
   Select the desired dynamic range and calculate the maximum input levels for both mixers. Remember that all levels must be in dB, dBμV or dBm. Let DR = 50 dB. IP3 for Mixer2 = 112 dBμV. Therefore, P_{inmax} = 87 dBμV. IP3 for Mixer1 = 127 dBμV. Therefore, P_{inmax} = 102 dBμV.

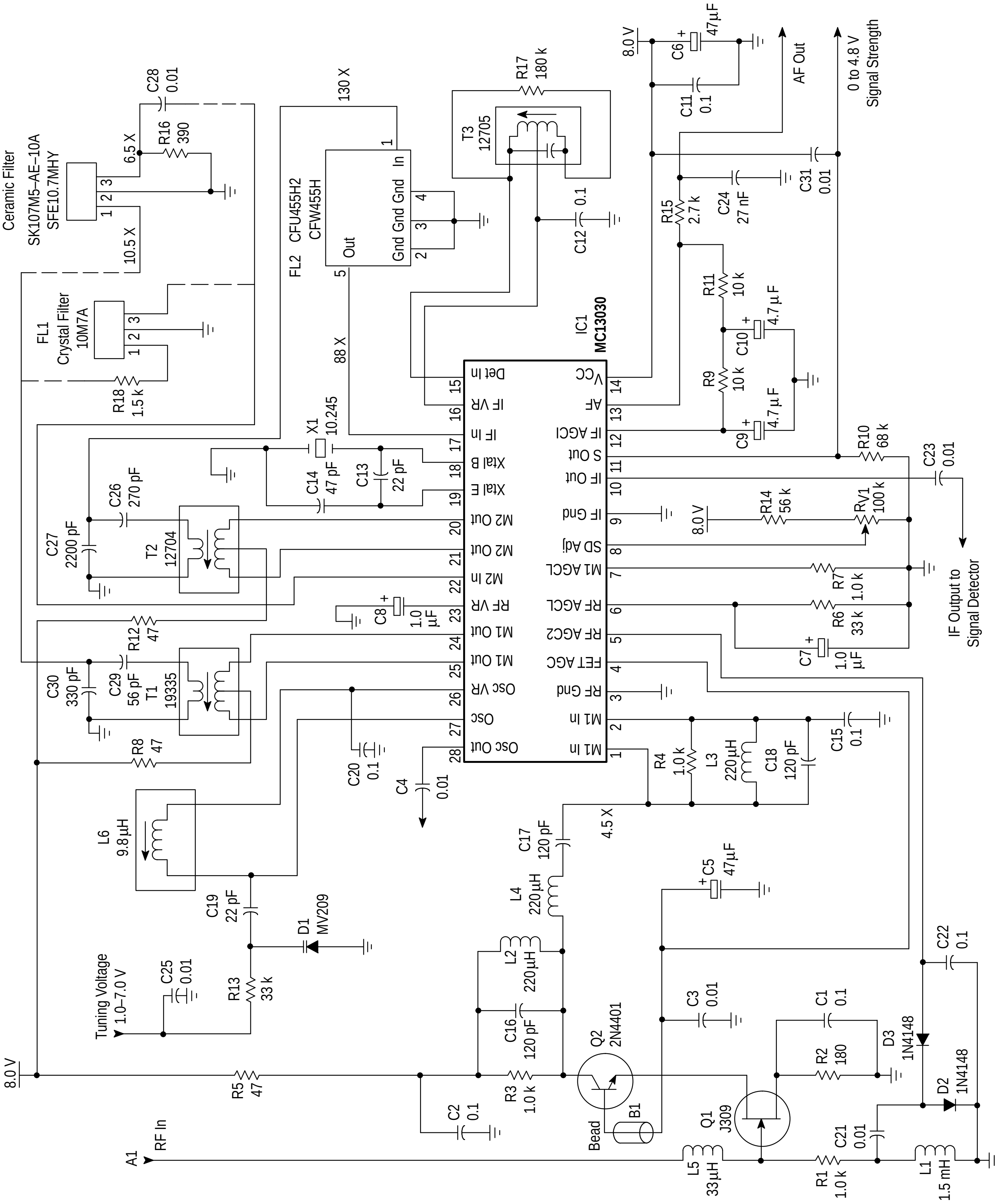
b. First, adjust the resistor from Pin 6 to ground to give the desired maximum input level to Mixer2. From the curve of Pin 6 current versus Mixer2 input level, R6 = 1.2/110 μA = 11 k. R_{int} = 39 k, so R_{6ext} = 15 k.

c. From the curve of Pin 6 current versus Mixer1 input level, determine how much more gain would be required in the Mixer1 AGC circuit to achieve the desired dynamic range for Mixer1. From the curve of Relative Sensitivity versus R7 determine the value of R7. Alternatively, R7 can be adjusted to give the desired maximum input level to Mixer1.

The resulting R7 may be too small to set the AGC threshold of Mixer1 as low as desired. Also, if R7 is less than 680 Ω, the AGC sensitivity for the Mixer1 input falls off at higher frequencies, so in these cases, the resistor from Pin 6 to ground must be reduced to achieve the desired level because the overload of Mixer1 provides the most important spurious response rejection. However, if the AGC level is set too high, the IF in signal may become too large and the IF amplifier can overload with strong signals. The values used in the application are more conservative.

The gain from the antenna input to the point being measured are shown on the AM radio application. These are helpful when calculating audio sensitivity and troubleshooting a new radio.

Figure 10. AM Radio Application



SW RADIO DESIGN NOTES

The shortwave receiver was designed to cover from 5.0 to 10 MHz. This MC13030 radio has better performance than most receivers because of the high dynamic range and spurious rejection of the mixers.

The RF stage bandpass filter for this radio is the same type as the one used for the car radio, but the series tuned section was scaled down in impedance to reduce the inductance of the coil.

Since most SW receivers include an SSB and CW mode, the detector coil could have a secondary winding to supply the second IF signal to this section.

The capacitors C10 and C23 have been reduced from those in the AM radio so that the AGC system can follow variations in signal level due to fading.

CB RADIO DESIGN NOTES

The RF stage bandpass filter for this radio consists of a tuned input and a double tuned interstage filter. For lower cost radios, a single tuned interstage filter could be used.

The schematic also shows a crystal 10.7 MHz 1st IF filter, but a ceramic or coil filter could also be used. An intermodulation rejection of 50 dB can be obtained with a ceramic 1st IF filter.

A bipolar transistor is shown for the RF stage. A dual gate CMOS FET could also be used with G2 connected to the AGC voltage on Pin 4. A PIN diode is recommended for D2.

COIL DATA

T1 – Toko A119ANS–19335UH

T2 – Toko A7MNS–12704UH

T3 – Toko A7MCS–12705Y

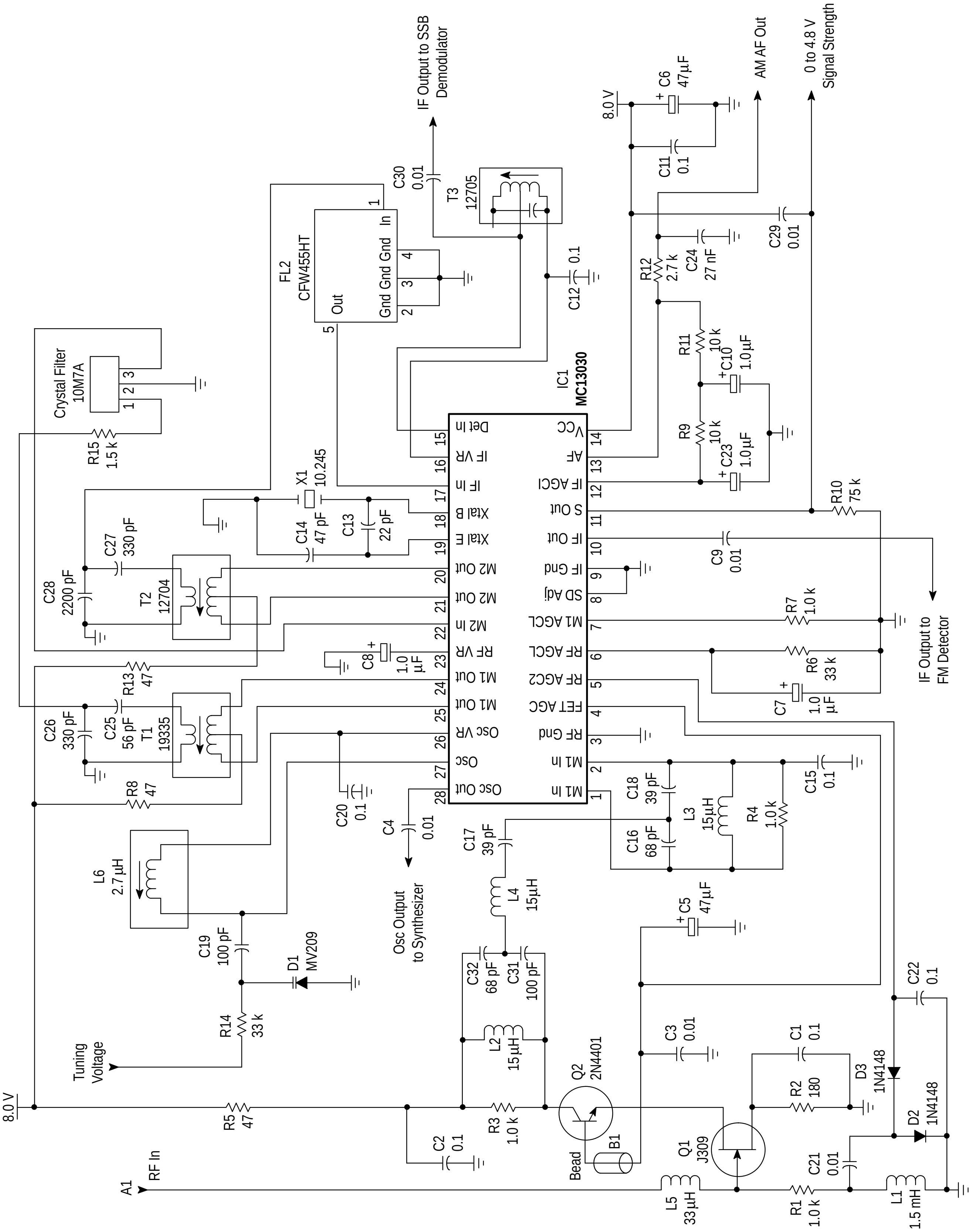


Figure 11. 5 to 10 MHz Radio Application

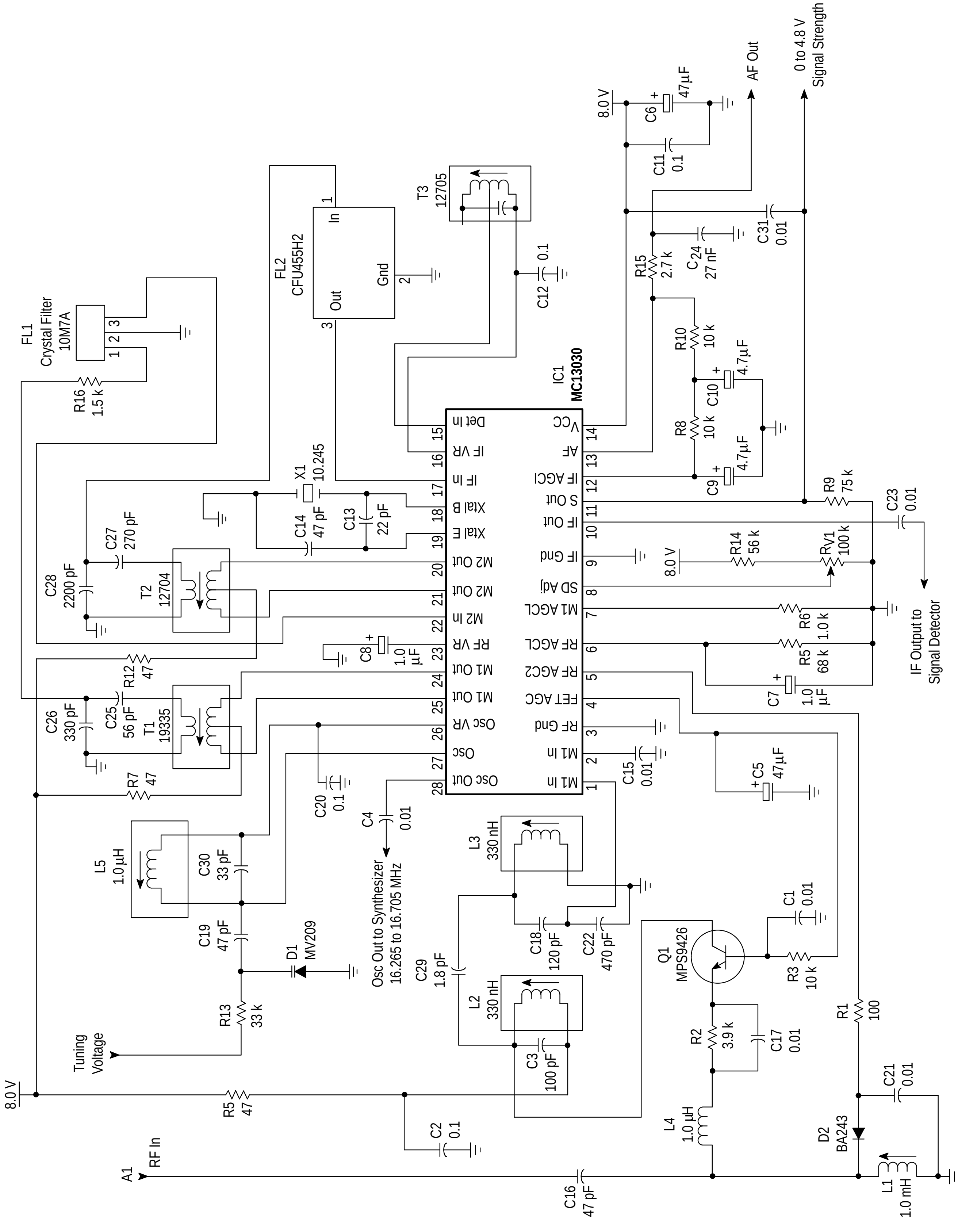
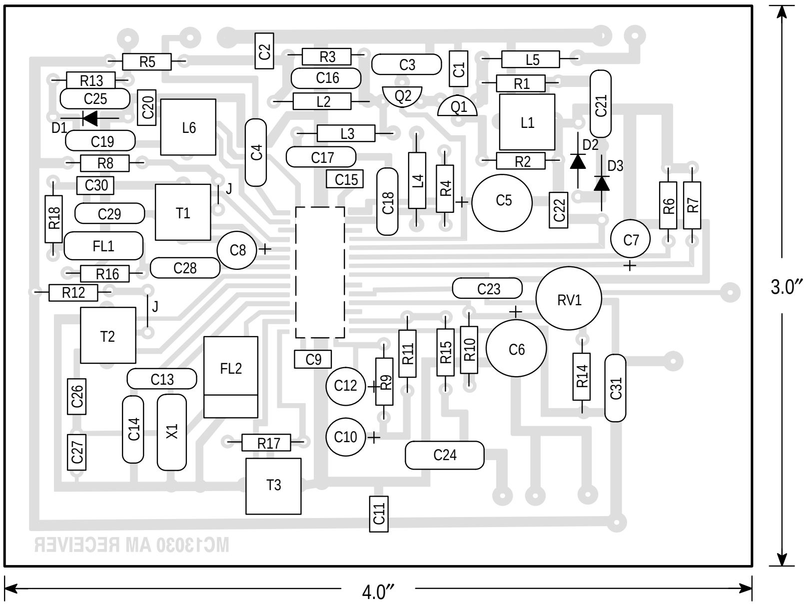


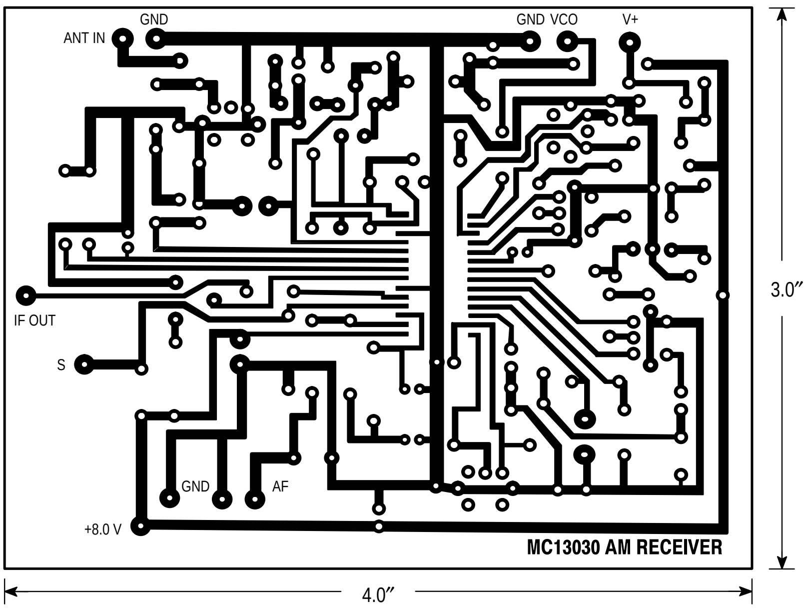
Figure 12. CB Radio Application

Figure 13. Printed Circuit Board



(Top View)

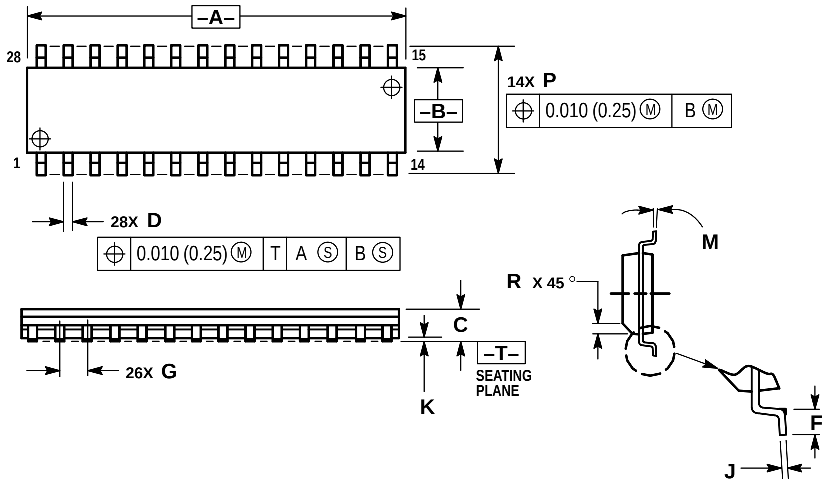
NOTE: J = Jumper



(Bottom View)

OUTLINE DIMENSIONS

DW SUFFIX
PLASTIC PACKAGE
CASE 751F–04
ISSUE E



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	17.80	18.05	0.701	0.711
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.01	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

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How to reach us:
USA / EUROPE / Locations Not Listed: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036. 1–800–441–2447 or 602–303–5454

MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609
INTERNET: http://Design–NET.com

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, 6F Seibu–Butsuryu–Center, 3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 03–81–3521–8315

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298

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