CMY 210 - 880 MHz to 85 MHz Down-Converter

Application Note No. 038

The CMY 210 is a ultralinear mixer with integrated LO-buffer for frequencies up to and exceeding 2.5 GHz. A low LO-input power of typically 0 dBm is sufficient to provide a very high input intercept point of typically 25 dBm at 3 V.
The input and output ports are 50 Ω matched. The device can be used as up- and down-converter.

Application Circuit

The mixer CMY 210 itself consists of a GaAs-FET used as a passive switch in parallel to the signal path. The LO-input power is amplified by a controlled amplifier which improves the overall performance.

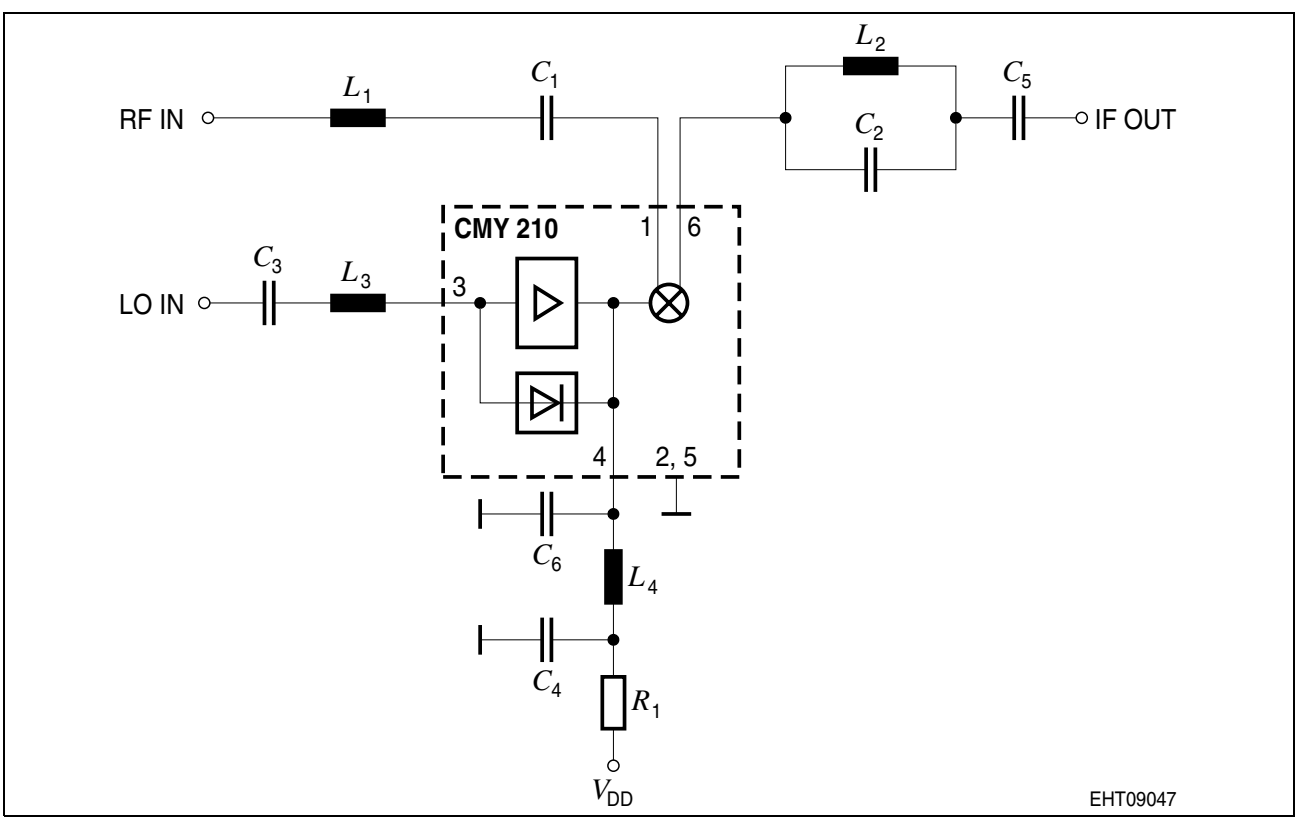


Figure 1 Application Circuit

Table 1 List of Components

L_1	8.2 nH Coilcraft 0805	C_2	3.9 pF 0603
L_2	8.2 nH Coilcraft 0805	C_3	33 pF 0603
L_3	6.8 nH Coilcraft 0805	C_4	33 pF 0603 parallel to 1 nF 0805 and 1 µF
L_4	15 nH Coilcraft 0805	C_5, C_6	Not required in this application
C_1	3.9 pF 0603	R_1	Not required in this application

Setup

1. In order to optimize power consumption, L_4 can be modified for minimum drain current: Switch on the local oscillator at the required LO-frequency and check the drain current. Adjust the LO-frequency to find the minimum current. If the minimum is detected at a lower frequency than the required LO-frequency, choose a lower value inductor for L_4; if detected at a higher frequency, choose a higher value.
2. Matching of IF- and RF-filters

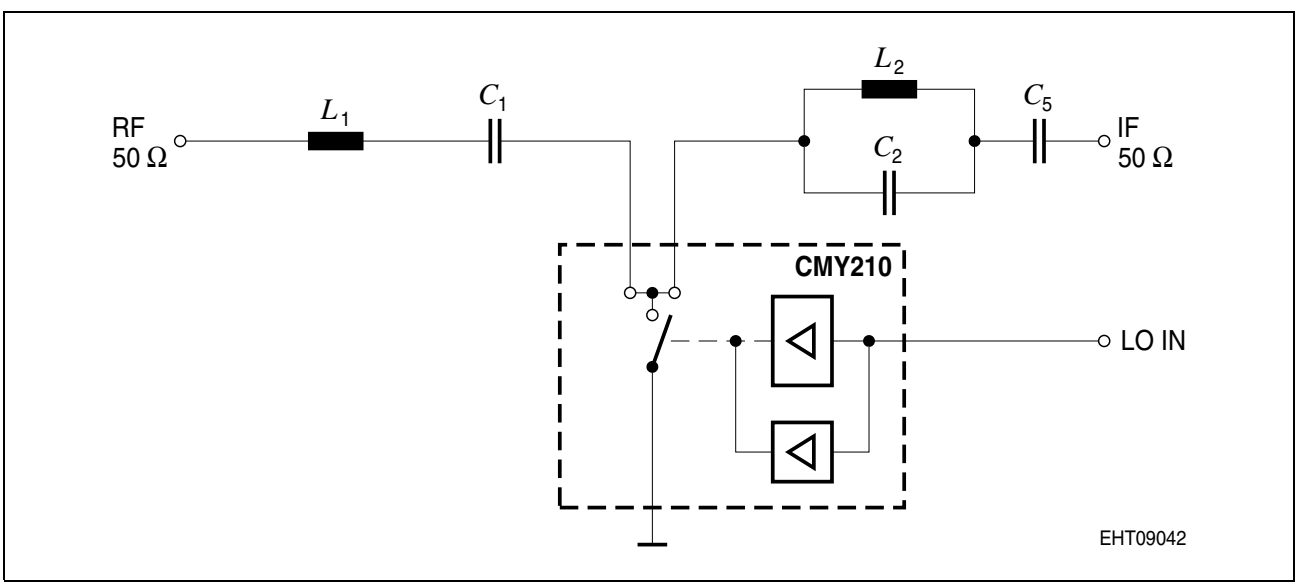


Figure 2 CMY 210 External Matching Circuit

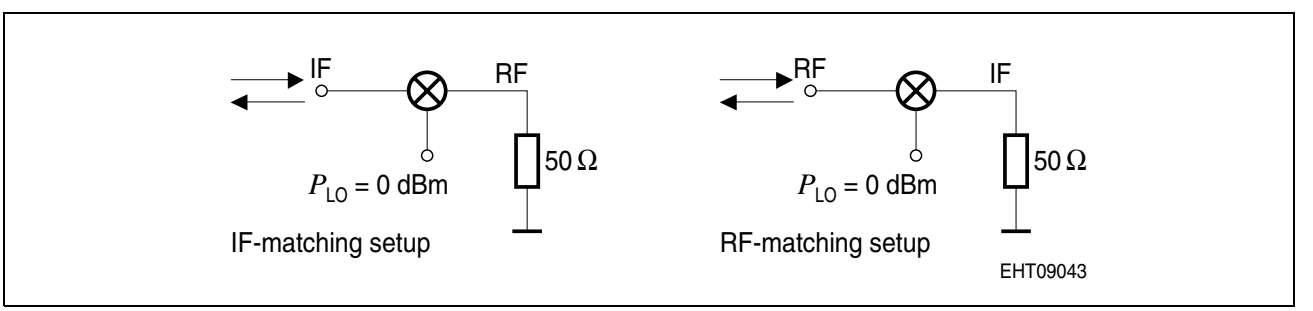


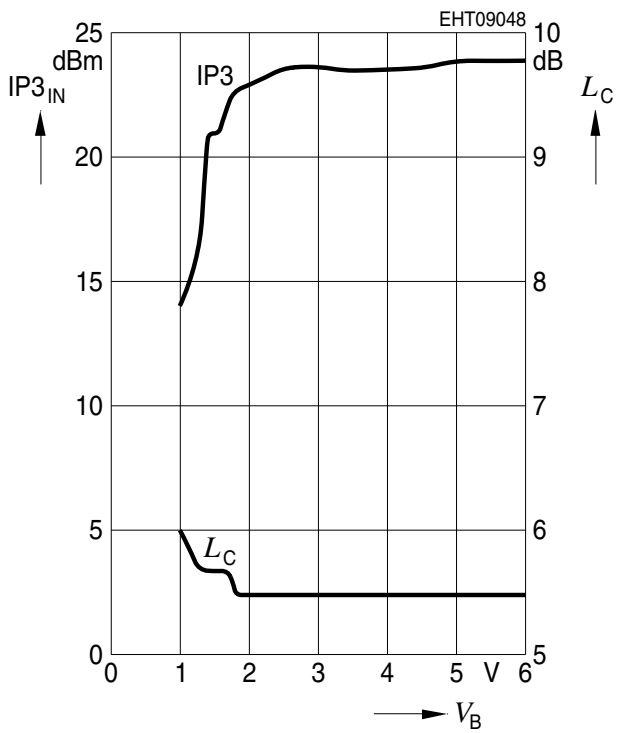
Figure 3 IF-Matching Setup and RF-Matching Setup

Usually both resonance filters (L_1, C_1 and L_2, C_2) are tuned to the RF-frequency. Filter L_1, C_1 passes the RF-frequency and reflects the IF-signal. Filter L_2, C_2 suppresses the RF-band and passes IF. An appropriate adjustment of the filters is the prerequisite to achieve a lower conversion loss. According to **Figure 2** the resonance frequency of the IF-filter L_2, C_2 ($f_{res} = 1/(2\pi\sqrt{L_2 \times C_2})$) can be adjusted to maximum reflection at f_{RF} by choosing appropriate inductors and capacitors. Correspondingly, the L_1, C_1 resonance frequency of RF-filter can be matched with minor modification of these values according to **Figure 2**. Since the IF- and RF-filters are connected with the ohmic resistor of the switching FET, matching of either filter might influence the matching parameters of the other filter.

3. At higher LO-frequencies (> 2 GHz) the gain of the LO buffer amplifier is already decreasing, causing a slightly lower IP_{3IN} and higher operating current.

4. The IP_{3IN} remains very constant with changes in operating voltage. A supply voltage of less than 2 V however will decrease the intermodulation performance. Please refer to the following figure. The conversion losses L_C are independent of the operating voltage as long as the switch transistor is not pinched off. The losses are mainly determined by the quality of IF- and RF-filters as mentioned in 2.

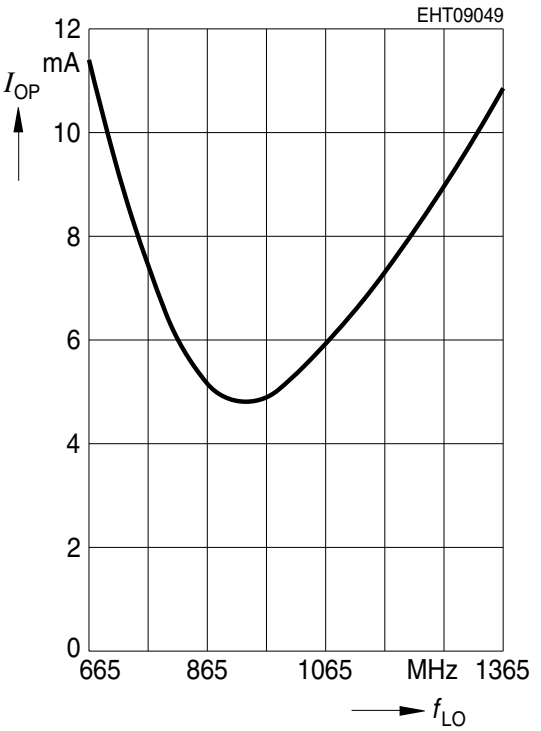
IP_{3IN}, L_C vs. Operation Voltage
f_{RF} = 880 MHz, P_{RF} = 2x-3 dBm,
f_{LO} = 965 MHz, P_{LO} = 0 dBm



5. The figure below shows the operating current over LO-frequency. A current minimum at approximately 965 MHz has been obtained by tuning the circuit for this LO-frequency as described in 2.

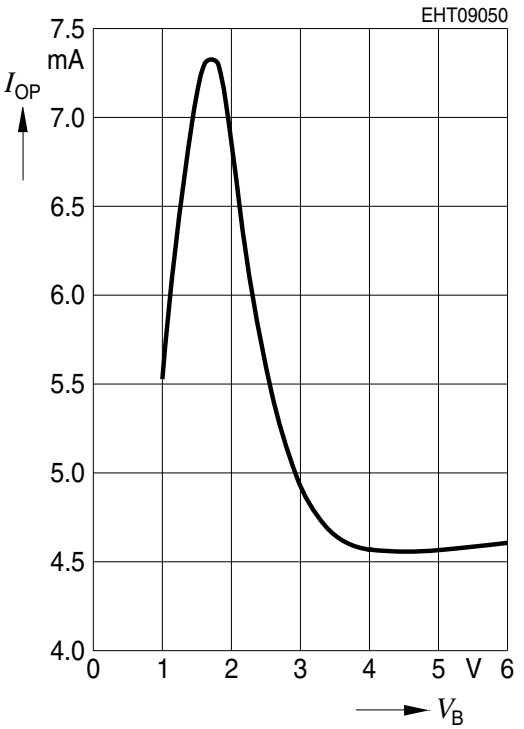
Operating Current vs. LO-Frequency

V_D = 3 V, P_{LO} = 0 dBm

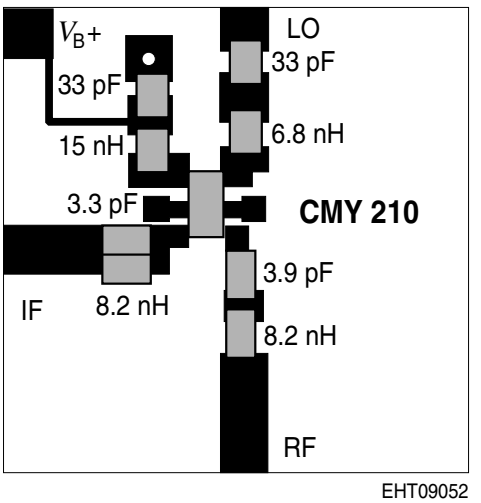


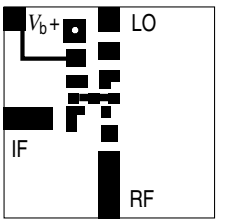
6. The operation current over the operating voltage at a fixed f_{LO} = 965 MHz is shown in the following figure.

Operation Current vs. Operation Voltage at f_{LO} = 965 MHz



Layout of 880 MHz to 85 MHz Down-Converter Application Board





Actual size 20 mm × 20 mm

Figure 4 Layout of Application Board

PCB - data: Glass fiber epoxy board (double sided), ε_r = 4.8, thickness = 1.0 mm

Characteristics of 880 MHz to 85 MHz Down-Converter Application Board

(Test conditions: V_D = 3.0 V; f_{RF} = 880 MHz; f_{LO} = 965 MHz; P_{LO} = 0 dBm; f_{IF} = 85 MHz; T_A = 25 °C; Z_O = 50 Ω)

Parameter	Symbol	Value	Unit
Operating current	I_{OP}	4.9	mA
Conversion Loss	L_C	5.5	dB
3rd Order Input Intercept Point	IP_{3IN}	+ 23.8	dBm
Return Loss (RF- /IF-Port)	RL	> 12	dB