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RENESAS

Application Note

Usage and Application of μPC8106, μPC8109 and μPC8163
2.0 GHz Silicon Frequency Up-converter ICs for Mobile Communications

Document No. P13683EJ2V0AN00 (2nd edition)
Date Published April 2000 N CP(K)

[MEMO]

NESAT is an abbreviation of NEC Silicon Advanced Technology and a trademark of NEC Corporation.

The information in this document will be updated without notice.
This document outlines a typical application of this product, that is, provides a sample concept for designing an external circuit directly required for this product. NEC only assures the quality and characteristics of this product specified in the Data Sheet, and is not responsible for any user's product designs or application sets.
The peripheral circuit shown in this document is just an example prepared for evaluating the operations of this product, and does not imply that the circuit configurations or constants are recommended values or regulations. In addition, these circuits are not intended for any mass-produced application sets. This is because the RF characteristics vary depending on the external parts used, mounting patterns, and other conditions.
Therefore, it is the responsibility of the user to design the external circuit according to the user-desired system requirements while referring to the information in this document and to use it after confirming the characteristics on the user's application set.

The mark ★ shows major revised points.

CONTENTS

Use-Related Cautions

(1) Observe precautions for handling because of electro-static sensitive devices.

(2) Form a ground pattern as wide as possible to minimize ground impedance (to prevent undesired oscillation). All the ground pins must be wired as short as possible to decrease impedance difference (this also helps prevent operation faults, abnormal oscillation, etc.).

(3) The bypass capacitor should be attached to the V_{CC} pin.

(4) The RF output pin connects an external LC matching circuit’s parallel inductor to V_{CC} to apply a bias and RF load.

(5) The DC cut capacitor must be attached to the input pin. The input pins’ voltage must not be externally adjusted.

(6) A capacitor (such as a 100 pF capacitor) should be attached between the PS and V_{CC} pins.

See each product’s data sheet for more detailed cautions and descriptions of electrical characteristics.

μPC8106T, μPC8109T Data Sheet (Document No. P10656E)
μPC8106TB, μPC8109TB Data Sheet (Document No. P12770E)
μPC8163TB Data Sheet (Document No. P13636E)

1. INTRODUCTION

In 1995, PDC (Personal Digital Cellular) services were launched in Japan, and PHS (Personal Handyphone System) services were started soon afterward. As of this writing near the end of the 1999 business term, Japan's cellular phone subscriptions totaled about 42.5 million, which would indicate that approximately one out of every three people in Japan has a cellular phone account. PHS subscriptions alone totaled nearly 6 million, which represents about 4.6 percent of the nation's population.

Mobile telephones using high frequencies need a frequency up-conversion function for RF signal transmission. This up-conversion function is applied to the following two modulation methods: direct modulation (or RF modulation), in which the signal is mixed up to the transmission frequency before being modulated, and other is indirect modulation (up converter method or IF modulation), in which the modulated signal of the IF frequency is up-converted to the transmission frequency. Frequency up-converters are used in all of these methods. NEC now adds the μPC8163 to the μPC8106 and μPC8109 silicon high-frequency monolithic integrated circuit lineup, which was developed to provide core products for frequency up-converters used with any of the above frequency modulation methods. This application note describes the usage and applications of this up-converter series.

★ 2. OVERVIEW OF PRODUCTS

2.1 Characteristics and Sizes

The μPC8106 is designed to emphasize low-distortion characteristics and the μPC8109 is designed to emphasize low current consumption. The μPC8163 is an improved distortion version of the μPC8106. The μPC8106 and μPC8109 have the same pin connections, however the power saving pin is absent in the μPC8163 because it does not include a power saving function. The supply voltage and frequency band are similarly identical in the μPC8106 and μPC8109, but differ slightly in the μPC8163 (refer to 3.2 Internal Circuit and Frequency Band for details). The μPC8106 and μPC8109 come in 6-pin minimold (2915 size) and 6-pin super minimold (2012 size) packages, whereas only the latter is available for the μPC8163. T or TB is added to the part number, indicating a conventional minimold and super minimold package, respectively.

Although products in this series with the same part number use the same circuit configuration, TB products have a smaller chip size. (By contrast, amplifier series products that have the same part number are all mounted on the same type of chip). The difference between μPC8106 and μPC8109 in the T and TB products of the μPC8106 and μPC8019 is a conversion gain specification of about 1 dB due to a slight gap in the IF input impedance. Specifications other than the conversion gain are the same.

A three-character abbreviation is used for the part numbers shown on the products, due to limited marking space on these small molds. “C2D” indicates the μPC8106, “C2G” indicates the μPC8109 and “C2Y” indicates the μPC8163.

For details of markings, see “Silicon High-frequency Monolithic ICs” (Document No. P10100E) in the selection guide.

Table 2-1 lists NEC’s lineup of high-frequency up converter ICs. Figure 2-1 shows package drawings of the two package types.

★ Table 2-1. NEC’s Lineup of High-Frequency Up Converter ICs

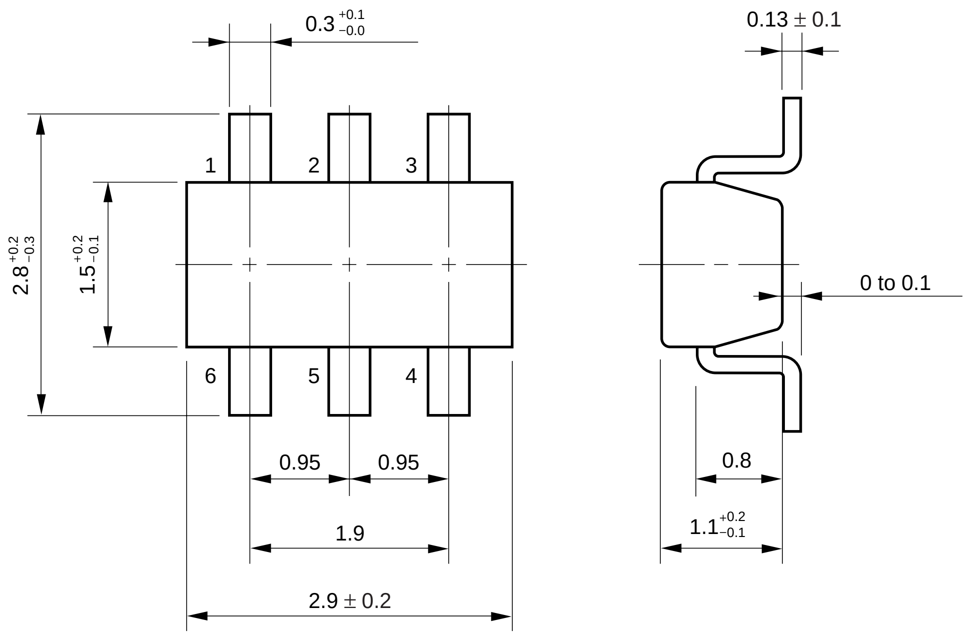
Part Number	Supply Voltage V_{CC} (V)	Circuit Current I_{CC} (mA)	Conversion Gain 1 CG1 (dB)	Conversion Gain 2 CG2 (dB)	Saturation RF Output Power 1 $P_{O\,(sat)}$ 1 (dBm)	Saturation RF Output Power 2 $P_{O\,(sat)}$ 2 (dBm)	Output $IP_3$1 $OIP_3$1(dBm)	Output $IP_3$2 $OIP_3$2(dBm)
μPC8106T	2.7 to 5.5	9	10	7	–2	–4	+5.5	+2.0
μPC8106TB			9	7				
μPC8109T	2.7 to 5.5	5	7	5	–6	–8	+1.5	–1.0
μPC8109TB			6	4	–5.5	–7.5		
μPC8163TB	2.7 to 3.3	16.5	9	5.5	0.5	–2	+9.5	+6.0

Test conditions: T_A = +25°C, V_{CC} = V_{RFout} = 3.0 V, Z_L = Z_S = 50 Ω (μPC8106, μPC8109: V_{PS} = 3.0 V)

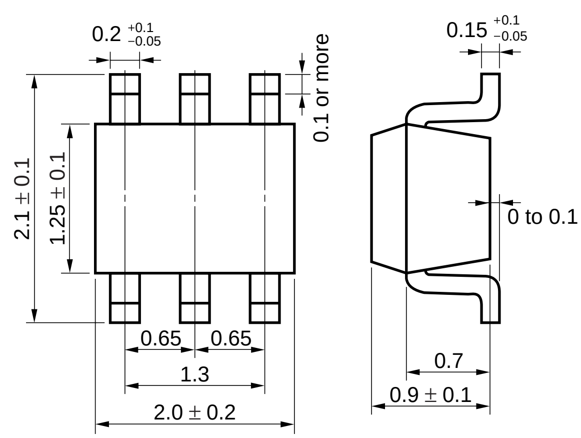
The above values are typical values for major characteristics. See each product’s data sheet for detailed characteristics ratings.

Figure 2-1. Package Drawings of 6-pin Minimold and 6-pin Super Minimold

(a) 6-pin minimold (unit: mm)



(b) 6-pin super minimold (unit: mm)



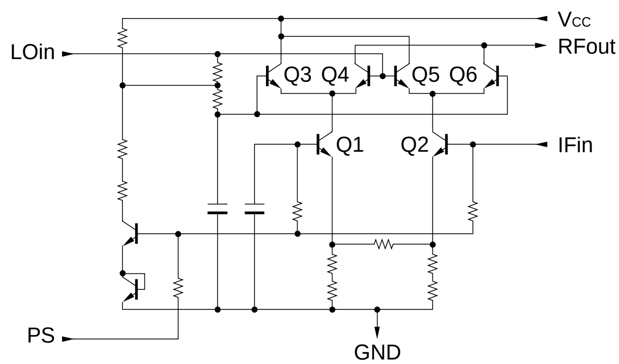
Both of these products have been developed and manufactured using NEC’s “NESAT III” silicon bipolar process. For details of this process, see the pamphlet entitled “NESAT Process” (Document No. P12647E).

★ 3. INTERNAL CIRCUIT CONFIGURATION

3.1 Differences Between μPC8106, μPC8109, and μPC8163

The μPC8106 and μPC8109 are double balanced mixer + bias circuit ICs and have the same circuit configuration. These circuits only differ in that the current across the Gilbert cell paired transistors (Q3, Q4 and Q5, Q6) in the μPC8106 is double that in the μPC8109. This results in a conversion gain difference of about 3 dB. The circuit configuration in the μPC8163 is the same as the other products in all respects except that there is no power saving control circuit. However, due to the optimization of the current distribution and the adjustment of CG and IIP_3, this product has a higher IP_3 value. The internal equivalent circuit is shown in Figure 3-1 below.

Figure 3-1. Internal Equivalent Circuit Diagram



3.2 Internal Circuits and Frequency Bandwidth

These ICs include bypass capacitors at the double balanced mixer type complementary IF inputs in order to improve the AC characteristics of the 100 MHz to 400 MHz frequency range (50 MHz to 300 MHz in the μPC8163). This lowers the conversion gain when the IF input frequency is below the minimum value. When the IF input frequency is above the maximum value, the conversion gain is lowered according to the frequency characteristics of the internal transistors. Figure 3-2 shows the dependence of the IF input frequency and the conversion gain in the μPC8106.

The RF output pin is an open collector, and since there is no on-chip component that limits the lower limit of the frequency bandwidth, the user should provide an external narrow-band matching circuit for the internal transistors' characteristic frequency range (μPC8106, μPC8109: 400 MHz to 2 GHz, μPC8163: 800 MHz to 2 GHz) to set the desired bandwidth.

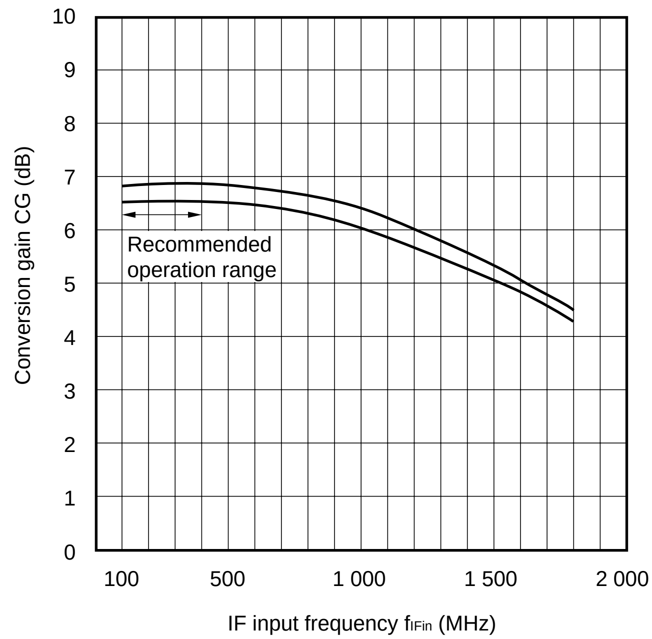
Since this mixer has been designed as a product for frequency up-converters, the user's determination of the desired bandwidth should be made according to the following conditions. Note with caution that this mixer's design and operation as a frequency down-converter are not guaranteed (other frequency down-converter mixer ICs are available).

- Frequency condition: $| f_{RFout} - f_{LOin} | = f_{IFin}$, f_{RFout}, $f_{LOin} > f_{IFin}$

Figure 3-2. Dependence of IF Input Frequency and Conversion Gain

μPC8106

Measurement conditions: f_{RFout} = 1.9 GHz, P_{LOin} = –5 dBm, V_{CC} = V_{PS} = V_{RFout} = 3.0 V, P_{IFin} = –30 dBm



★ 4. EXTERNAL CIRCUIT CONFIGURATION

4.1 Impedance Matching at RF Output

Since this IC has an open-collector output, an external LC matching circuit for RF should be included in the circuit configuration. The matching circuit should include a parallel inductor to the V_{CC} side and a series capacitor to the next stage. As mentioned earlier, the bias of the output pin's collector is applied via the inductor used for RF matching of the V_{CC} pin's voltage. In other words, the inductor that is connected to the output pin has two effects: its RF effect (frequency matching) and its DC effect (application of bias). For this reason, the external inductor should be a small DC-resistance and high frequency use type.

The LC matching circuit constants used in the test circuits shown in the data sheet are for the evaluation board described in the data sheet. This evaluation board is used only for simple evaluations; devices evaluated using this board are not immediately suitable for application in systems. The patterns used for evaluation do not allow parts to be mounted near the IC, so the pattern size is larger. Accordingly, these are not the recommended patterns or the recommended circuit constants.

The matching LC value is determined so as to produce a narrow-band power gain that suits the frequency bandwidth used, based on the IC's own S parameters. Select a value that reduces the S_{22} value to about –20 dBm when the gain within the frequency bandwidth used is at the maximum. A 900 MHz high pass type and a 1.5 GHz and 1.9 GHz low pass type are shown as example of an RF matching circuit configuration.

4.2 Input Impedance Matching

The IF and LO inputs in this IC are base inputs with parallel connections to bias resistors. Although their characteristic impedance is not 50 Ω, the test circuits in the data sheet show a signal generator with a 50 Ω signal source impedance. Accordingly, the data sheet's electrical characteristics include loss due to this mismatched impedance. If impedance matching is implemented in the actual circuit, the elimination of this loss raises the IC's input level, which lowers the required input level (by about 3 to 5 dB). When configuring an IF matching circuit, such as is shown in Figure 4-1, the response time varies according to the IF matching circuit's DC cut series capacitance value (see **5.1 Operating Rise/Fall Times**).

Figure 4-3 shows S parameter values for RF, IF, and LO ports when matching is not implemented. Although the internal components are the same in the T and TB products, the packages, leads, and chip sizes are different, which means that the S parameters are slightly different, so some optimization is needed (concerning peripheral circuit constants, mounting pads, etc.) when replacing one package with the other.

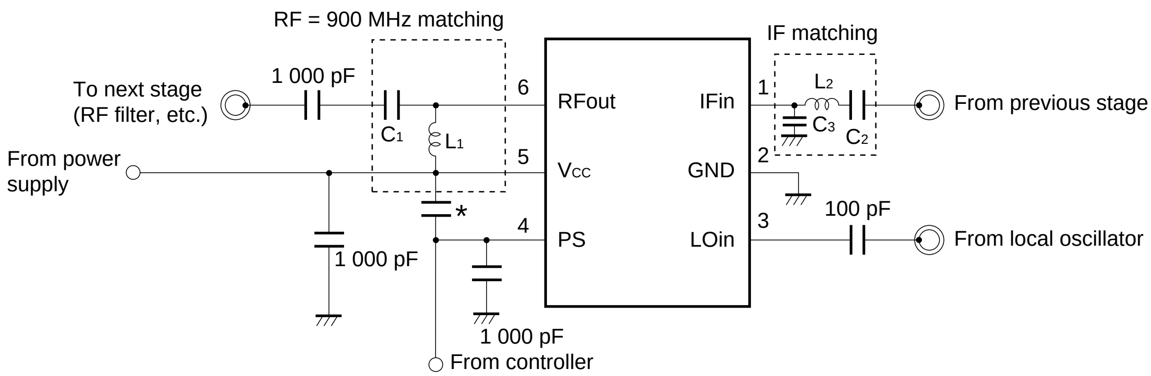
4.3 Bypass Capacitor

As in other ICs, in this IC the V_{CC} pin must be GND in RF, so externally attach a bypass capacitor with a large value such as 1 000 pF. In the μPC8106 and μPC8109, the conversion value is higher or lower depending on the board. This difference is based on the relationship between the IC's internal elements and board, and the pattern length. If the conversion gain on the board of the actual set is low, it can be improved by inserting an external chip capacitor of about 100 pF between the V_{CC} and PS pins to readjust the matching.

Figure 4-1. Examples of External Circuit Configuration (μPC8106, μPC8109) (1/2)

RF output matched at 900 MHz

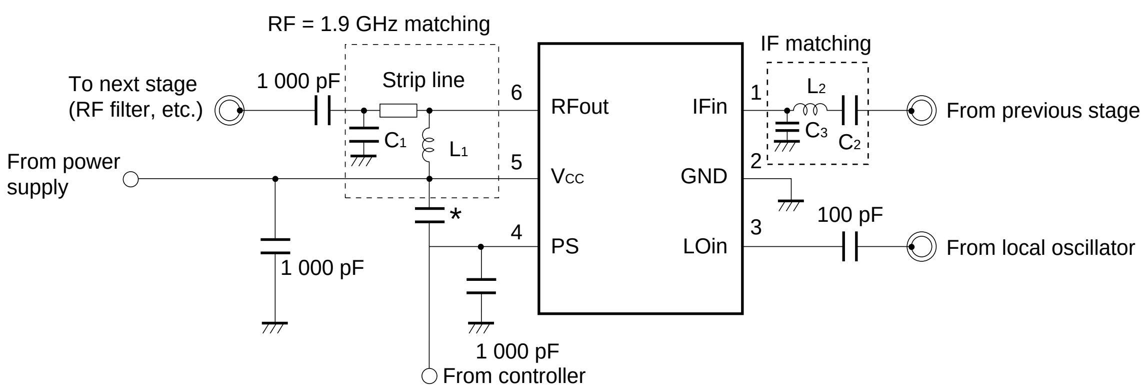
Determine L_1 and C_1 according to the frequency and the RF port's S parameter.
High-pass type output matching is used.
Determine whether or not attach an input matching circuit according to the impedance of the previous stage.



* If gain is reduced on the mounting board, insert a 100 pF capacitor between the V_{CC} and PS pins to readjust the matching.

RF output matched at 1.9 GHz

Determine L_1 and C_1 according to the frequency (including the strip line length on the mounting board) and the RF port's S parameter.
Low-pass type output matching is used.
Determine whether or not attach an input matching circuit according to the impedance of the previous stage.
If the conversion gain value is too low, implementing a parallel configuration of two chip capacitors for C_1 can lower the Q value.

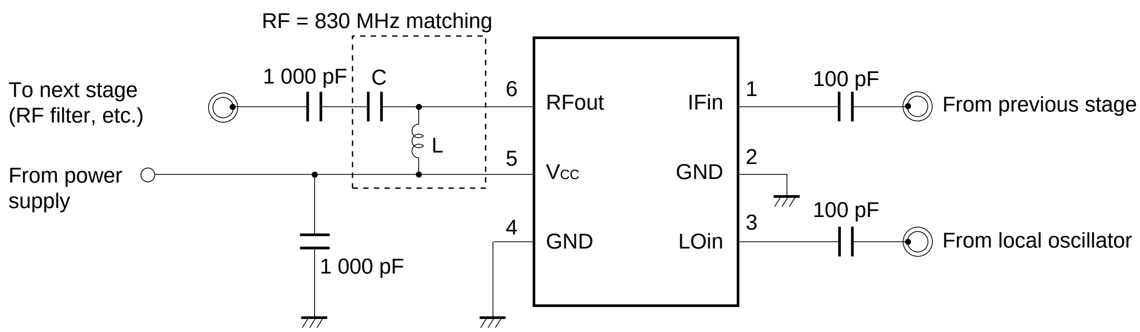


* If gain is reduced on the mounting board, insert a 100 pF capacitor between the V_{CC} and PS pins to readjust the matching.

★ **Figure 4-1. Examples of Circuit Configuration (μPC8163) (2/2)**

RF output matched at 830 MHz

Determine L and C according to the frequency and the RF port's S parameter.
High-pass type output matching is used.
Determine whether or not to attach an input matching circuit according to the impedance of the previous stage.



RF output matched at 1.9 GHz

Determine L and C according to the frequency (including the strip line length on the mounting board) and the RF port's S parameter.
Low-pass type output matching is used.
Determine whether or not to attach an input matching circuit according to the impedance of the previous stage.
If the conversion gain is too low, implementing a parallel configuration of two chip capacitors for C can lower the Q value.

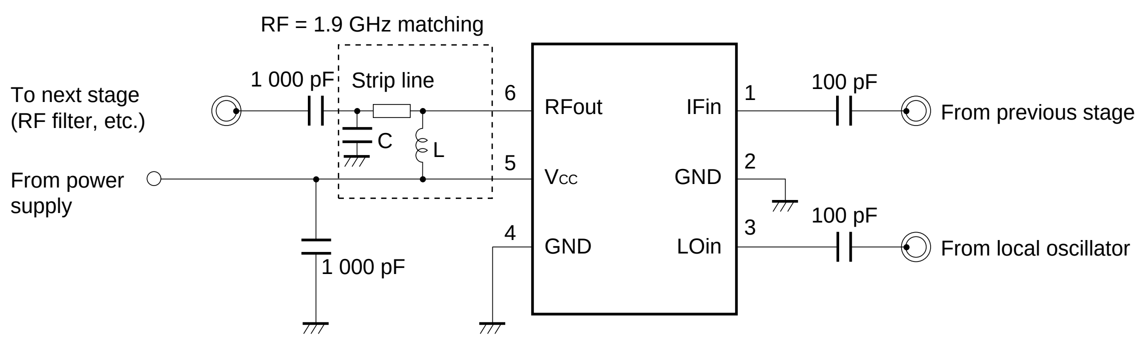
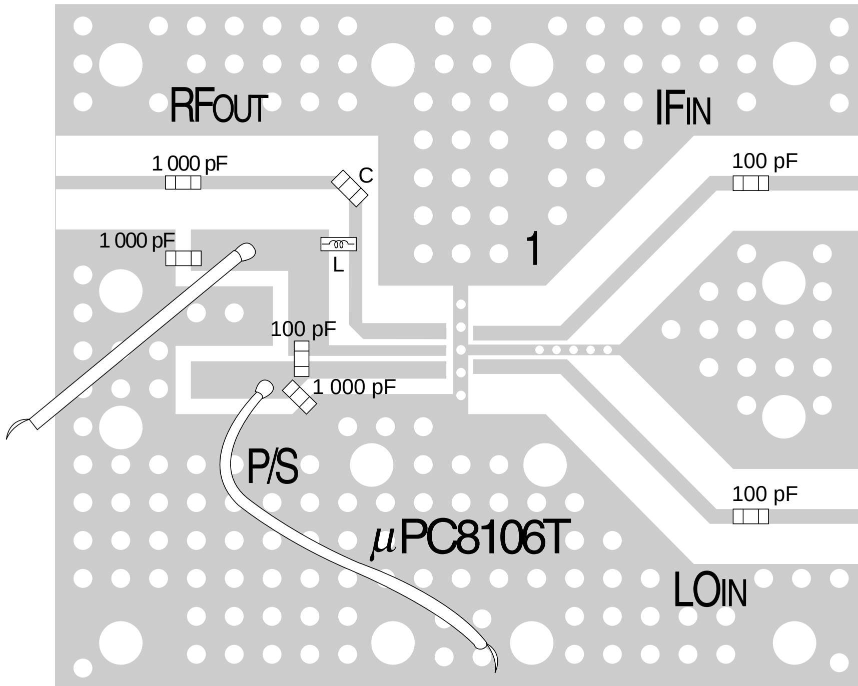
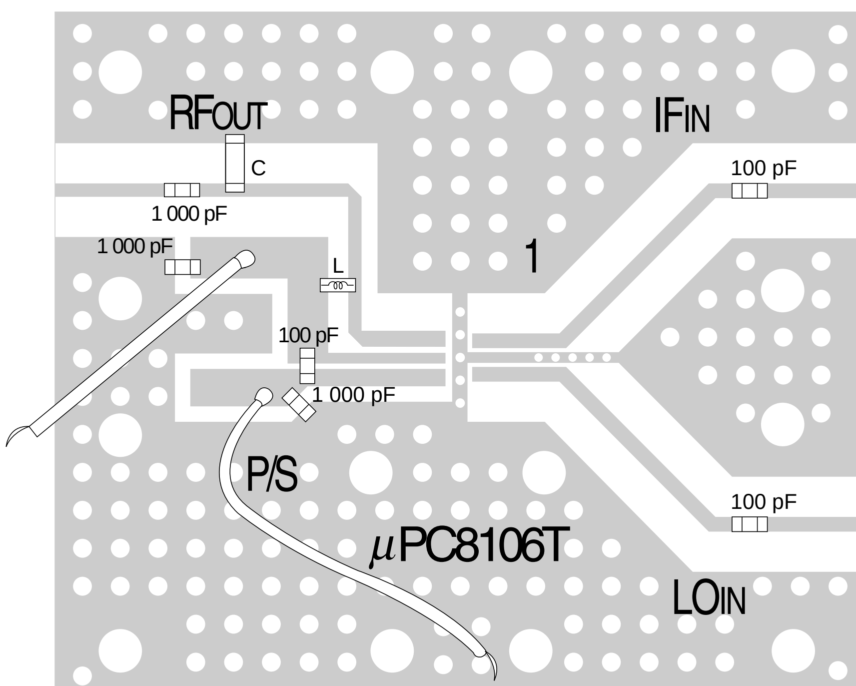


Figure 4-2. Examples of External Circuit Configuration on the Evaluation Board

RF output matched at 900 MHz



RF output matched at 1.9 GHz



Caution Although the VCC and PS pins are shorted in the μPC8106 and μPC8109 data sheet due to the NEC test equipment conditions, it is possible to independently control the VCC and PS pins in actual evaluation by using a pulse generator that assumes PS pin control via logic.

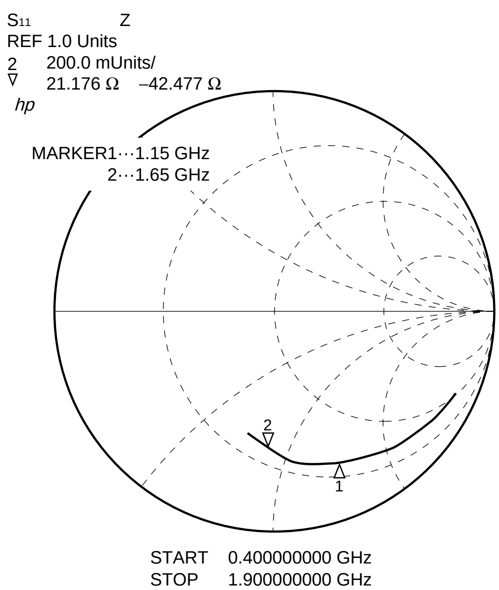
Figure 4-3. S Parameters and Smith Charts (Without External Component) (1/10)

(a) μPC8106T (1/2)

(V_{CC} = V_{PS} = V_{RFout} = 3.0 V, T_A = +25°C)

FREQUENCY	LO port S_{11}		RF port S_{22}	
MHz	MAG.	ANG.	MAG.	ANG.
400.0000	0.889	–25.2	0.968	–19.4
450.0000	0.880	–28.2	0.964	–21.8
500.0000	0.871	–31.0	0.958	–24.2
550.0000	0.861	–34.1	0.951	–26.5
600.0000	0.852	–36.9	0.945	–28.7
650.0000	0.841	–39.7	0.937	–31.1
700.0000	0.831	–42.6	0.933	–33.2
750.0000	0.822	–45.4	0.924	–35.4
800.0000	0.812	–48.2	0.919	–37.5
850.0000	0.800	–51.0	0.910	–40.0
900.0000	0.791	–53.7	0.901	–42.2
950.0000	0.778	–56.2	0.895	–44.2
1000.0000	0.771	–58.8	0.890	–46.5
1050.0000	0.757	–61.6	0.884	–48.5
1100.0000	0.753	–64.1	0.874	–50.6
1150.0000	0.735	–66.7	0.869	–52.6
1200.0000	0.728	–69.6	0.860	–55.0
1250.0000	0.721	–72.0	0.854	–57.0
1300.0000	0.709	–74.5	0.844	–59.3
1350.0000	0.703	–77.3	0.839	–61.4
1400.0000	0.694	–80.3	0.830	–63.5
1450.0000	0.684	–83.0	0.825	–65.3
1500.0000	0.668	–86.2	0.814	–67.6
1550.0000	0.651	–88.7	0.804	–69.4
1600.0000	0.633	–91.2	0.796	–71.5
1650.0000	0.616	–93.0	0.792	–73.5
1700.0000	0.602	–95.1	0.783	–75.4
1750.0000	0.593	–96.9	0.776	–77.2
1800.0000	0.585	–98.8	0.769	–79.4
1850.0000	0.577	–100.6	0.762	–81.3
1900.0000	0.566	–102.9	0.754	–83.4

LO port



RF port

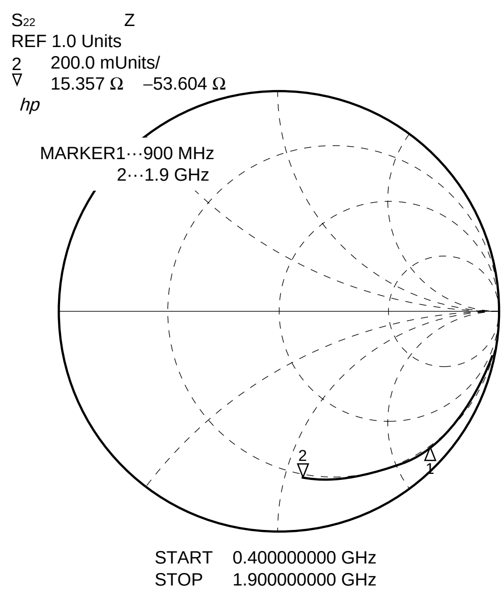


Figure 4-3. S Parameters and Smith Charts (Without External Component) (2/10)

(a) μPC8106T (2/2)

	IF port	
FREQUENCY	S_{11}	
MHz	MAG.	ANG.
100.0000	0.938	–4.5
120.0000	0.937	–5.2
140.0000	0.936	–6.0
160.0000	0.934	–6.9
180.0000	0.932	–7.7
200.0000	0.931	–8.5
220.0000	0.928	–9.4
240.0000	0.927	–10.2
260.0000	0.926	–11.2
280.0000	0.924	–11.9
300.0000	0.922	–12.9
320.0000	0.921	–13.6
340.0000	0.917	–14.4
360.0000	0.916	–15.3
380.0000	0.910	–15.9
400.0000	0.909	–16.9

IF port

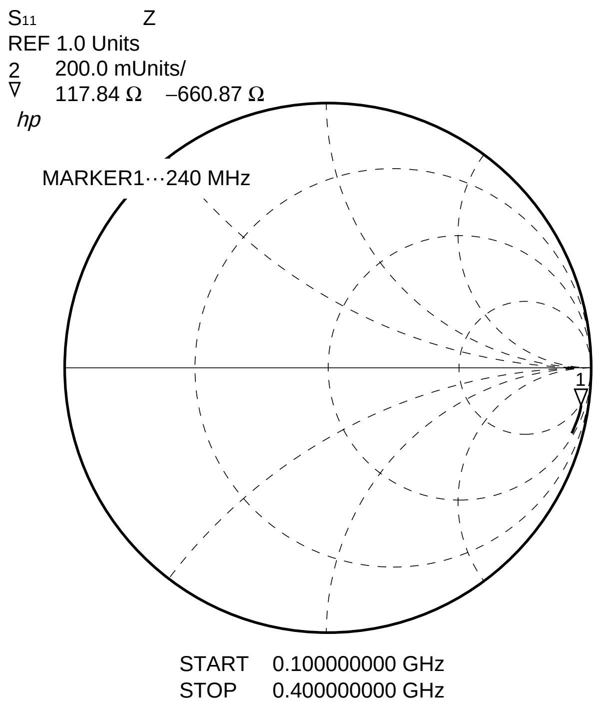


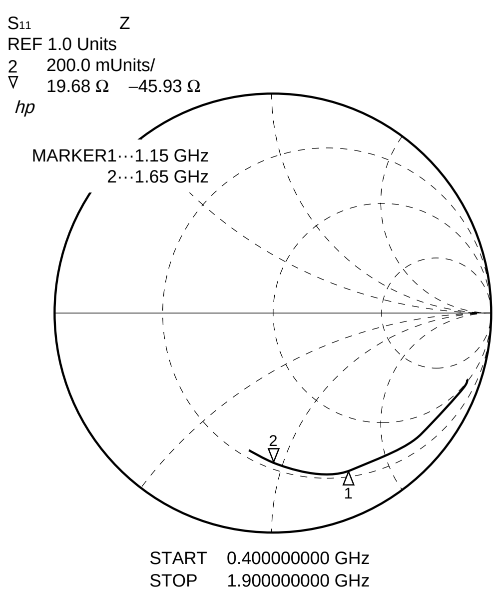
Figure 4-3. S Parameters and Smith Charts (Without External Component) (3/10)

(b) μPC8109T (1/2)

(V_{CC} = V_{PS} = V_{RFout} = 3.0 V, T_A = +25°C)

	LO port		RF port	
FREQUENCY	S_{11}		S_{22}	
MHz	MAG.	ANG.	MAG.	ANG.
400.0000	0.913	–23.7	0.971	–19.4
450.0000	0.904	–26.5	0.967	–21.9
500.0000	0.897	–29.3	0.962	–24.2
550.0000	0.889	–32.2	0.956	–26.5
600.0000	0.880	–34.8	0.949	–28.8
650.0000	0.871	–37.5	0.944	–31.0
700.0000	0.863	–40.3	0.940	–33.3
750.0000	0.855	–42.9	0.930	–35.5
800.0000	0.846	–45.7	0.926	–37.7
850.0000	0.835	–48.5	0.918	–40.1
900.0000	0.829	–51.1	0.913	–42.5
950.0000	0.819	–53.6	0.904	–44.5
1000.0000	0.813	–56.1	0.898	–46.8
1050.0000	0.802	–58.8	0.891	–48.7
1100.0000	0.799	–61.5	0.885	–50.9
1150.0000	0.785	–64.2	0.880	–52.9
1200.0000	0.776	–66.9	0.870	–55.1
1250.0000	0.772	–69.4	0.868	–57.4
1300.0000	0.760	–72.1	0.858	–59.7
1350.0000	0.755	–75.2	0.851	–62.0
1400.0000	0.745	–78.0	0.845	–63.9
1450.0000	0.731	–81.3	0.837	–65.8
1500.0000	0.711	–84.2	0.830	–68.1
1550.0000	0.691	–86.3	0.822	–70.2
1600.0000	0.674	–88.5	0.813	–72.6
1650.0000	0.659	–89.9	0.807	–74.4
1700.0000	0.648	–91.9	0.799	–76.5
1750.0000	0.643	–94.0	0.792	–78.4
1800.0000	0.638	–95.8	0.784	–80.3
1850.0000	0.632	–97.8	0.775	–82.3
1900.0000	0.622	–100.3	0.767	–84.7

LO port



RF port

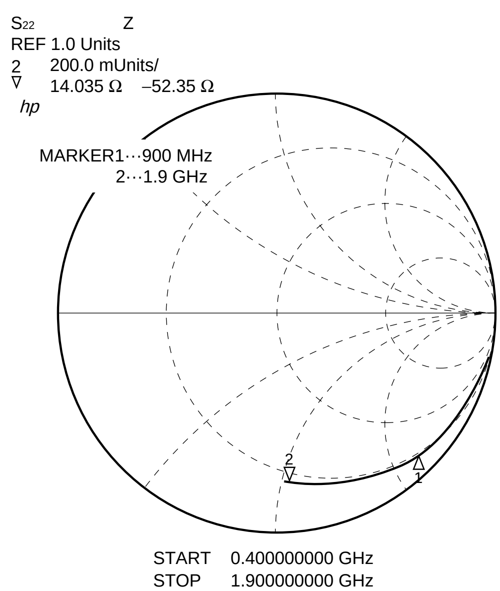


Figure 4-3. S Parameters and Smith Charts (Without External Component) (4/10)

(b) μPC8109T (2/2)

FREQUENCY	IF port S11	
MHz	MAG.	ANG.
100.0000	0.949	–4.3
120.0000	0.950	–5.0
140.0000	0.950	–5.7
160.0000	0.948	–6.6
180.0000	0.945	–7.4
200.0000	0.944	–8.2
220.0000	0.940	–9.0
240.0000	0.940	–9.9
260.0000	0.939	–10.7
280.0000	0.937	–11.5
300.0000	0.935	–12.4
320.0000	0.936	–13.2
340.0000	0.931	–13.8
360.0000	0.930	–14.7
380.0000	0.925	–15.4
400.0000	0.923	–16.2

IF port

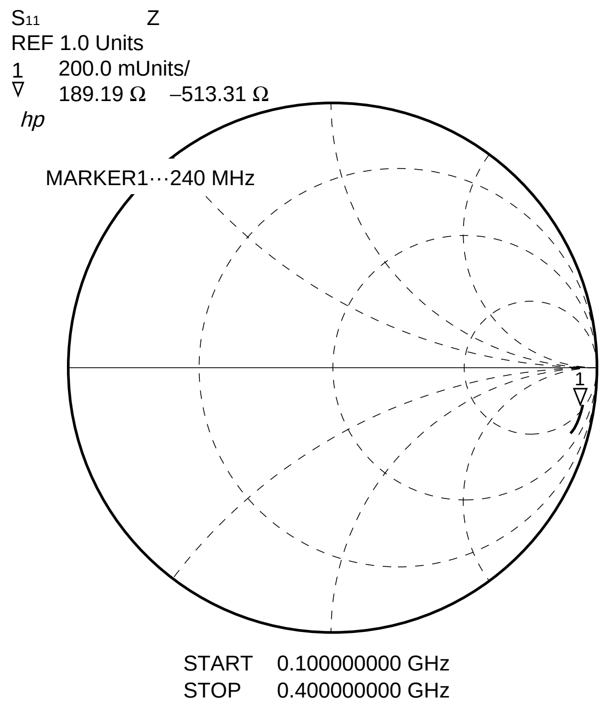


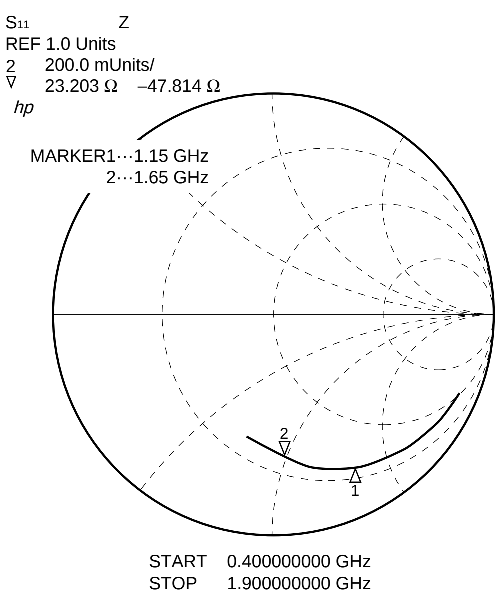
Figure 4-3. S Parameters and Smith Charts (Without External Component) (5/10)

(c) μPC8106TB (1/2)

($V_{CC} = V_{PS} = V_{RFout}$ = 3.0 V, T_A = +25°C)

FREQUENCY	LO port S_{11}		RF port S_{22}	
MHz	MAG.	ANG.	MAG.	ANG.
400.0000	0.902	–23.2	0.966	–13.6
450.0000	0.894	–26.1	0.962	–15.4
500.0000	0.888	–28.7	0.959	–17.1
550.0000	0.878	–31.5	0.951	–18.5
600.0000	0.870	–34.2	0.948	–20.1
650.0000	0.858	–36.9	0.939	–21.8
700.0000	0.852	–39.5	0.934	–23.1
750.0000	0.842	–42.1	0.928	–24.8
800.0000	0.834	–44.8	0.922	–26.3
850.0000	0.824	–47.6	0.915	–27.8
900.0000	0.810	–50.3	0.907	–29.3
950.0000	0.801	–52.7	0.901	–30.8
1000.0000	0.796	–55.3	0.897	–32.5
1050.0000	0.781	–57.9	0.889	–33.8
1100.0000	0.777	–60.5	0.879	–35.4
1150.0000	0.760	–63.0	0.871	–37.0
1200.0000	0.749	–65.5	0.862	–38.4
1250.0000	0.739	–67.9	0.851	–40.3
1300.0000	0.728	–70.7	0.839	–41.6
1350.0000	0.716	–73.2	0.827	–43.2
1400.0000	0.702	–76.2	0.809	–44.2
1450.0000	0.684	–78.7	0.797	–45.7
1500.0000	0.666	–80.6	0.781	–46.1
1550.0000	0.651	–82.5	0.773	–46.3
1600.0000	0.636	–84.5	0.775	–47.0
1650.0000	0.627	–86.1	0.774	–47.9
1700.0000	0.618	–88.0	0.774	–49.4
1750.0000	0.608	–90.0	0.772	–50.6
1800.0000	0.600	–91.9	0.766	–51.9
1850.0000	0.591	–94.0	0.763	–53.3
1900.0000	0.579	–96.1	0.760	–54.8

LO port



RF port

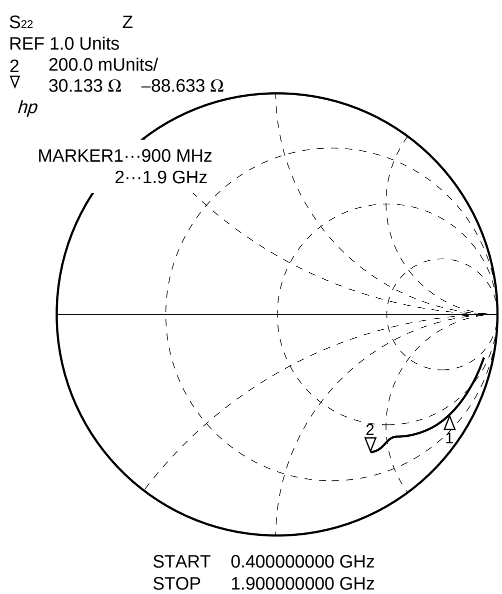


Figure 4-3. S Parameters and Smith Charts (Without External Component) (6/10)

(c) μPC8106TB (2/2)

	IF port	
FREQUENCY	S_{11}	
MHz	MAG.	ANG.
100.0000	0.946	–4.2
120.0000	0.946	–4.9
140.0000	0.944	–5.6
160.0000	0.942	–6.4
180.0000	0.941	–7.2
200.0000	0.939	–8.0
220.0000	0.938	–8.8
240.0000	0.935	–9.5
260.0000	0.936	–10.1
280.0000	0.935	–11.0
300.0000	0.932	–11.8
320.0000	0.929	–12.5
340.0000	0.928	–13.2
360.0000	0.925	–14.0
380.0000	0.923	–14.7
400.0000	0.920	–15.4

IF port

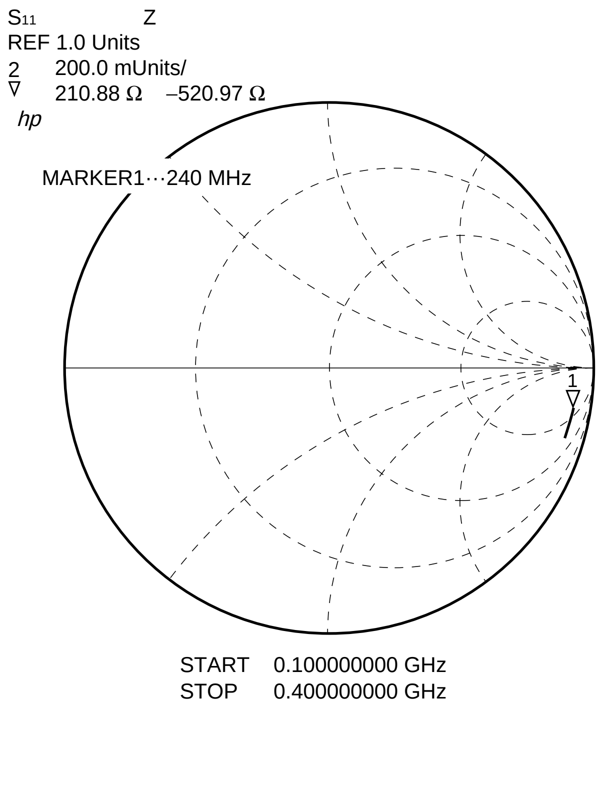


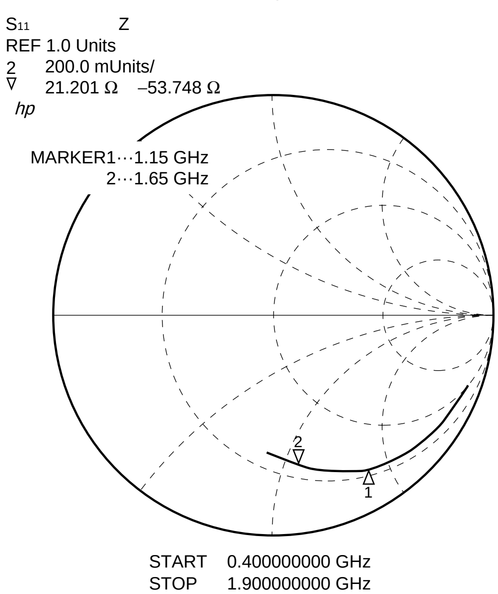
Figure 4-3. S Parameters and Smith Charts (Without External Component) (7/10)

(d) μPC8109TB (1/2)

(V_{CC} = V_{PS} = V_{RFout} = 3.0 V, T_A = +25°C)

FREQUENCY	LO port S_{11}		RF port S_{22}	
MHz	MAG.	ANG.	MAG.	ANG.
400.0000	0.929	–21.3	0.971	–13.4
450.0000	0.920	–23.9	0.967	–15.1
500.0000	0.915	–26.4	0.963	–16.8
550.0000	0.908	–29.0	0.956	–18.3
600.0000	0.900	–31.6	0.952	–19.8
650.0000	0.894	–34.1	0.946	–21.4
700.0000	0.887	–36.5	0.941	–22.8
750.0000	0.879	–39.0	0.935	–24.5
800.0000	0.873	–41.6	0.932	–25.9
850.0000	0.864	–44.0	0.924	–27.3
900.0000	0.852	–46.6	0.917	–29.0
950.0000	0.845	–48.9	0.916	–30.6
1000.0000	0.842	–51.3	0.907	–32.2
1050.0000	0.830	–53.9	0.901	–33.6
1100.0000	0.829	–56.6	0.892	–35.2
1150.0000	0.811	–59.0	0.885	–36.6
1200.0000	0.804	–61.6	0.877	–38.1
1250.0000	0.795	–64.0	0.869	–39.8
1300.0000	0.785	–66.5	0.858	–41.3
1350.0000	0.773	–69.2	0.848	–43.0
1400.0000	0.756	–72.1	0.833	–44.2
1450.0000	0.736	–74.5	0.824	–45.6
1500.0000	0.719	–76.2	0.810	–46.4
1550.0000	0.703	–77.9	0.802	–47.0
1600.0000	0.692	–79.6	0.802	–48.0
1650.0000	0.683	–81.2	0.797	–49.1
1700.0000	0.678	–82.9	0.795	–50.5
1750.0000	0.670	–85.1	0.792	–51.9
1800.0000	0.662	–86.8	0.788	–53.3
1850.0000	0.653	–88.8	0.780	–54.7
1900.0000	0.642	–90.9	0.776	–56.2

LO port



RF port

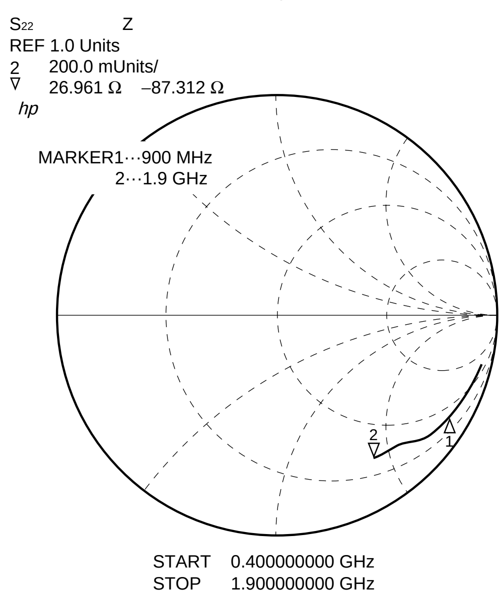


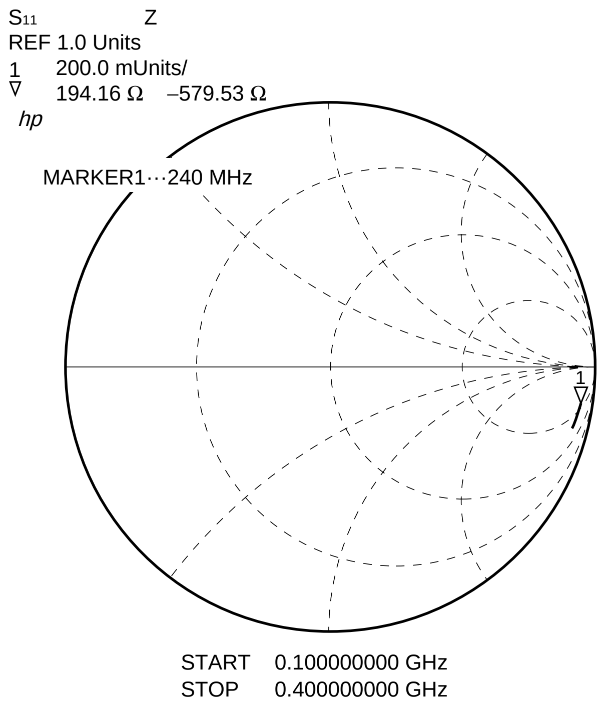
Figure 4-3. S Parameters and Smith Charts (Without External Component) (8/10)

(d) μPC8109TB (2/2)

IF port

FREQUENCY	S_{11}	
MHz	MAG.	ANG.
100.0000	0.960	–3.8
120.0000	0.959	–4.5
140.0000	0.957	–5.2
160.0000	0.956	–6.0
180.0000	0.956	–6.7
200.0000	0.953	–7.4
220.0000	0.953	–8.2
240.0000	0.950	–8.9
260.0000	0.950	–9.5
280.0000	0.946	–10.4
300.0000	0.948	–11.1
320.0000	0.947	–11.7
340.0000	0.943	–12.5
360.0000	0.942	–13.1
380.0000	0.940	–13.9
400.0000	0.938	–14.5

IF port

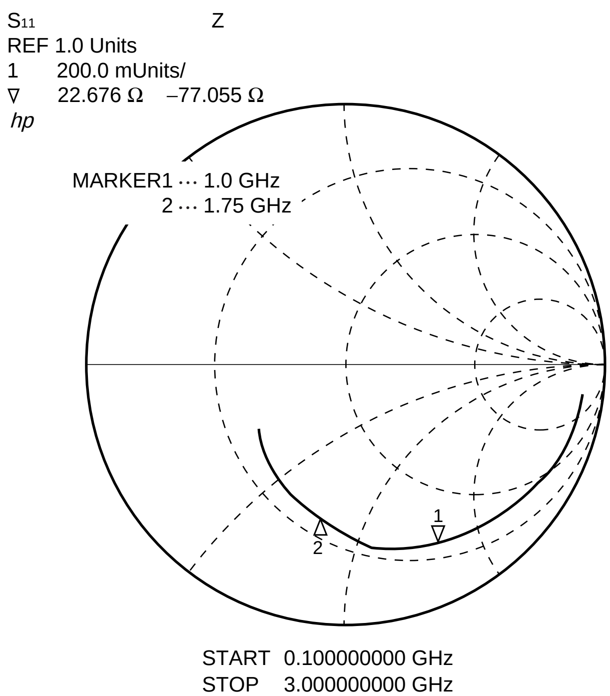


★ **Figure 4-3. S Parameters and Smith Charts (Without External Component) (9/10)**

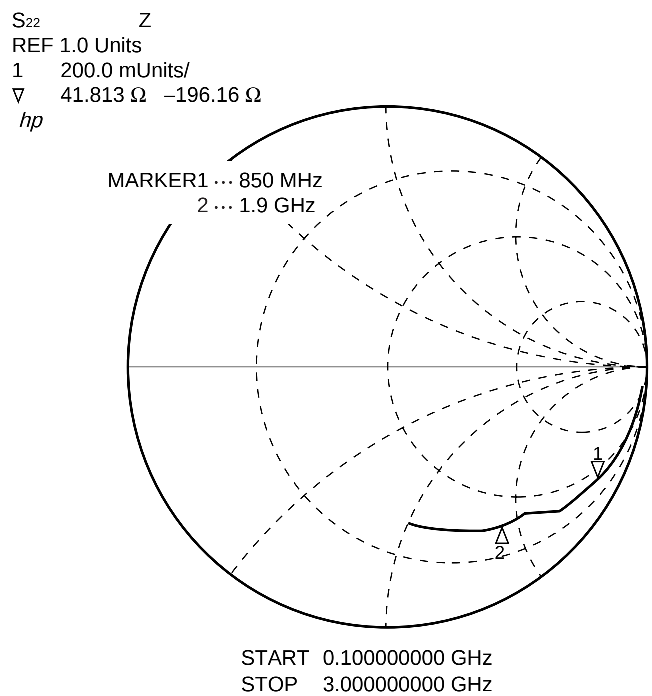
(e) μPC8163TB (1/2)
($V_{CC} = V_{RFout}$ = 3.0 V, T_A = +25°C)

FREQUENCY	LO Port S_{11}		RF Port S_{22}	
MHz	MAG.	ANG.	MAG.	ANG.
100.0000	0.917	–7.4	0.985	–3.5
150.0000	0.915	–10.7	0.982	–5.2
200.0000	0.911	–14.0	0.982	–6.9
250.0000	0.905	–17.0	0.977	–8.5
300.0000	0.898	–20.4	0.972	–10.2
350.0000	0.893	–23.8	0.966	–12.0
400.0000	0.883	–27.0	0.964	–13.5
450.0000	0.877	–30.2	0.959	–15.1
500.0000	0.867	–33.2	0.953	–16.5
550.0000	0.860	–36.5	0.946	–18.3
600.0000	0.850	–39.6	0.939	–19.7
650.0000	0.839	–42.6	0.932	–21.3
700.0000	0.831	–45.6	0.926	–22.9
750.0000	0.822	–48.7	0.922	–24.3
800.0000	0.812	–51.5	0.915	–25.7
850.0000	0.801	–54.4	0.907	–27.3
900.0000	0.790	–57.4	0.902	–28.9
950.0000	0.778	–60.3	0.891	–30.2
1000.0000	0.773	–62.9	0.885	–31.4
1050.0000	0.761	–65.6	0.880	–32.9
1100.0000	0.759	–68.4	0.870	–34.3
1150.0000	0.743	–71.0	0.862	–35.8
1200.0000	0.733	–73.8	0.859	–37.2
1250.0000	0.728	–76.5	0.850	–39.3
1300.0000	0.717	–79.3	0.833	–40.7
1350.0000	0.711	–82.4	0.820	–41.9
1400.0000	0.693	–85.3	0.803	–43.4
1450.0000	0.680	–88.2	0.788	–44.3
1500.0000	0.662	–90.6	0.773	–44.7
1550.0000	0.646	–92.7	0.770	–45.1
1600.0000	0.629	–95.0	0.767	–45.7
1650.0000	0.618	–96.6	0.766	–46.8
1700.0000	0.611	–98.4	0.764	–47.9
1750.0000	0.601	–100.4	0.759	–49.3
1800.0000	0.592	–102.2	0.752	–50.3
1850.0000	0.584	–104.2	0.753	–51.5
1900.0000	0.576	–106.3	0.747	–52.8
1950.0000	0.568	–108.2	0.741	–54.1
2000.0000	0.560	–110.0	0.733	–55.4
2050.0000	0.550	–112.0	0.730	–56.6
2100.0000	0.543	–113.9	0.721	–57.7
2150.0000	0.535	–115.6	0.715	–58.7
2200.0000	0.527	–117.5	0.711	–60.1
2250.0000	0.519	–119.3	0.703	–61.2
2300.0000	0.512	–120.8	0.698	–62.5
2350.0000	0.505	–122.6	0.691	–63.7
2400.0000	0.499	–124.4	0.687	–64.9
2450.0000	0.489	–126.1	0.666	–66.4
2500.0000	0.485	–127.9	0.659	–67.5
2550.0000	0.478	–129.4	0.653	–68.8
2600.0000	0.472	–131.1	0.646	–70.1
2650.0000	0.463	–132.6	0.640	–71.3
2700.0000	0.460	–134.1	0.636	–72.4
2750.0000	0.454	–135.6	0.631	–73.6
2800.0000	0.450	–137.1	0.618	–75.0
2850.0000	0.443	–139.2	0.616	–76.4
2900.0000	0.437	–140.5	0.613	–77.3
2950.0000	0.430	–142.2	0.605	–78.3
3000.0000	0.424	–143.6	0.603	–79.4

LO port



RF port



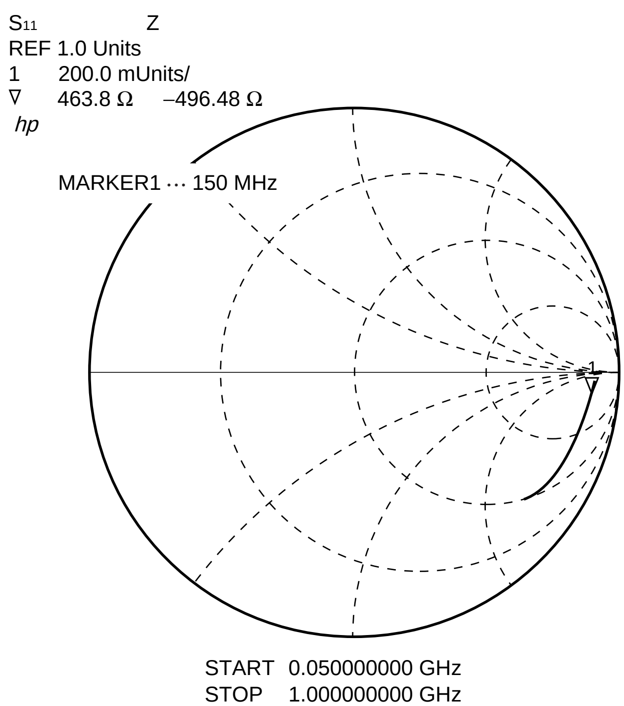
★ **Figure 4-3. S Parameters and Smith Charts (Without External Component) (10/10)**

(e) μPC8163TB (2/2)

IF port

FREQUENCY	S_{11}	
MHz	MAG.	ANG.
50.0000	0.911	–2.3
100.0000	0.908	–4.2
150.0000	0.905	–6.2
200.0000	0.904	–8.1
250.0000	0.900	–10.0
300.0000	0.895	–12.0
350.0000	0.890	–13.9
400.0000	0.888	–15.7
450.0000	0.882	–17.6
500.0000	0.879	–19.5
550.0000	0.873	–21.3
600.0000	0.869	–23.0
650.0000	0.861	–24.8
700.0000	0.855	–26.5
750.0000	0.849	–28.4
800.0000	0.844	–30.1
850.0000	0.836	–31.7
900.0000	0.832	–33.4
950.0000	0.823	–35.1
1000.0000	0.815	–36.9

IF port



★ 5. APPLICATION CHARACTERISTICS

5.1 Operating Rise/Fall Times

The measurement of the V_{CC} and PS pins' rise and fall time is carried out by using a pulse pattern generator to control the pins' ON/OFF status at high speeds, and the zero-scan mode of a spectrum analyzer to set the maximum/minimum transition time of the output level of the desired RF frequency. Bearing in mind the dependency of the DC cut capacitor on the rise time, a DC cut capacitor of about 100 pF is required to get the same value (2 μs) as the data sheet. The measurement results are shown in Table 5-1. In addition, the rising/falling waveform of the μPC8106TB is shown in Figure 5-1 as an illustrative example.

Table 5-1. Rise/Fall Times for IF Pin DC Cut Capacitance

- **Rise time**

Part Number	Control Pin[Note]	IF Input Pin DC Cut Capacitance		
		1 000 pF	400 pF	100 pF
μPC8106TB	PS	12 μs	5 μs	2 μs
	V_{CC}	7 μs	3 μs	1.5 μs
	Both PS and V_{CC}	12 μs	6 μs	2 μs
μPC8109TB	PS	14 μs	6 μs	2 μs
	V_{CC}	10 μs	4 μs	2 μs
	Both PS and V_{CC}	14 μs	6 μs	2.5 μs
μPC8163TB	V_{CC}	4.5 μs	2 μs	1.5 μs

- **Fall time**

Part Number	Control Pin[Note]	IF Input Pin DC Cut Capacitance		
		1 000 pF	400 pF	100 pF
μPC8106TB	PS	7.5 μs	3 μs	1.5 μs
	V_{CC}	1 μs	0.5 μs	1 μs
	Both PS and V_{CC}	1 μs	0.5 μs	1 μs
μPC8109TB	PS	9 μs	4 μs	1.5 μs
	V_{CC}	1 μs	1 μs	1 μs
	Both PS and V_{CC}	1 μs	1 μs	1 μs
μPC8163TB	V_{CC}	1 μs	1 μs	0.5 μs

Note
- PS pin control .....Apply 3 V constantly to the V_{CC} pin, input the ON/OFF pulse waveform to the PS pin
- V_{CC} pin control ....Apply 3 V constantly to the PS pin, input the ON/OFF pulse waveform to the V_{CC} pin
- PS, V_{CC} pin simultaneous control ......Input the ON/OFF pulse waveform simultaneously to the V_{CC} and PS pins

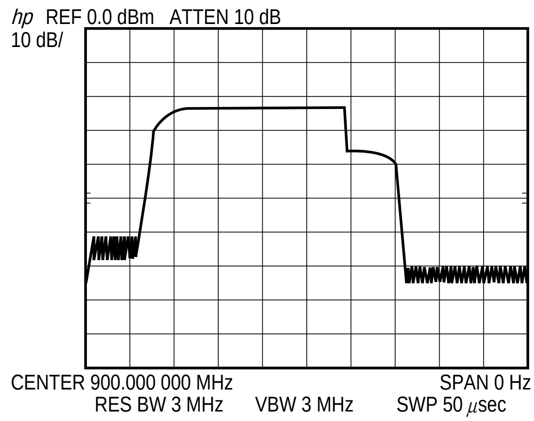
★ **Figure 5-1. Rising/Falling Waveforms of μPC8106TB (1/3)**

Measurement conditions: f_{IFin} = 240 MHz, P_{IFin} = –30 dBm, f_{LOin} = 1 140 MHz, P_{LOin} = –5 dBm

(a) PS pin control

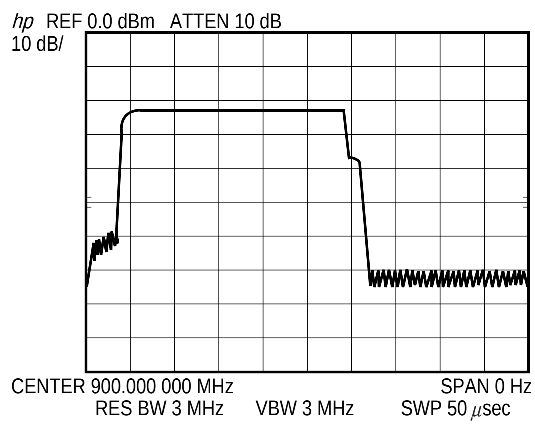
- **For 1 000 pF DC cut capacitor**

  Rise time
  T_{rise} = 12 μs
  Fall time
  T_{fall} = 7.5 μs



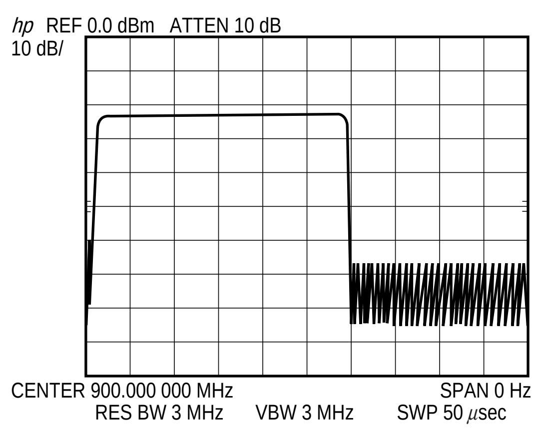
- **For 400 pF DC cut capacitor**

  Rise time
  T_{rise} = 5 μs
  Fall time
  T_{fall} = 3 μs



- **For 100 pF DC cut capacitor**

  Rise time
  T_{rise} = 2 μs
  Fall time
  T_{fall} = 1.5 μs



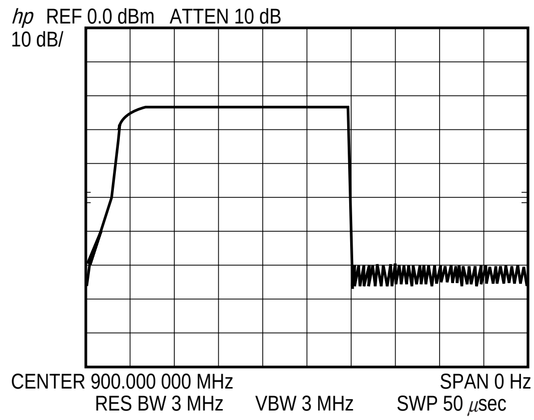
★ **Figure 5-1. Rising/Falling Waveforms of μPC8106TB (2/3)**

Measurement conditions: f_{IFin} = 240 MHz, P_{IFin} = –30 dBm, f_{LOin} = 1 140 MHz, P_{LOin} = –5 dBm

(b) V_{CC} pin control

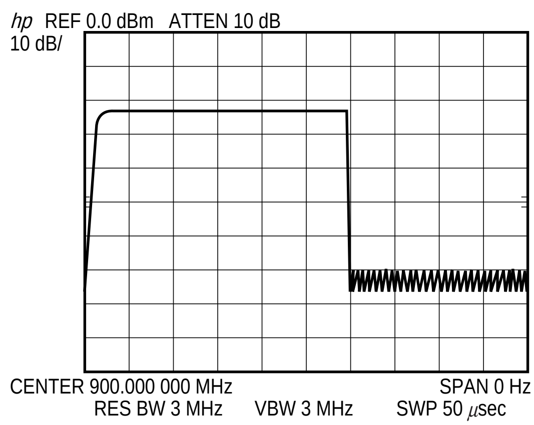
- **For 1 000 pF DC cut capacitor**

Rise time
T_{rise} = 7 μs
Fall time
T_{fall} = 1 μs



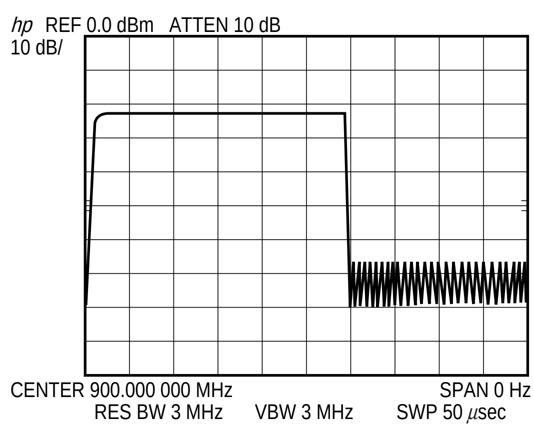
- **For 400 pF DC cut capacitor**

Rise time
T_{rise} = 3 μs
Fall time
T_{fall} = 0.5 μs



- **For 100 pF DC cut capacitor**

Rise time
T_{rise} = 1.5 μs
Fall time
T_{fall} = 1 μs



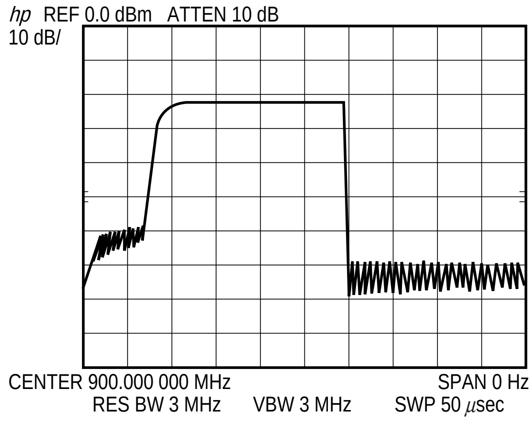
★ **Figure 5-1. Rising/Falling Waveforms of μPC8106TB (3/3)**

Measurement conditions: f_{IFin} = 240 MHz, P_{IFin} = –30 dBm, f_{LOin} = 1 140 MHz, P_{LOin} = –5 dBm

(c) Simultaneous control of PS, V_{CC} pins

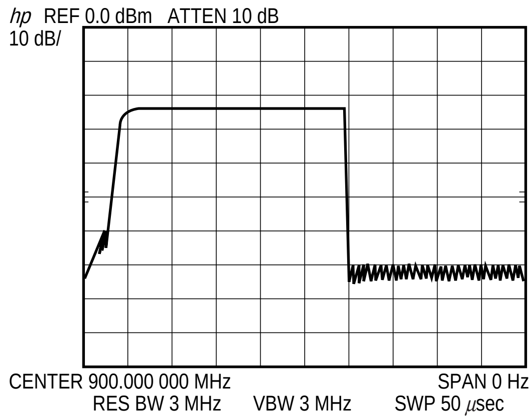
- **For 1 000 pF DC cut capacitor**

Rise time
T_{rise} = 12 μs
Fall time
T_{fall} = 1 μs



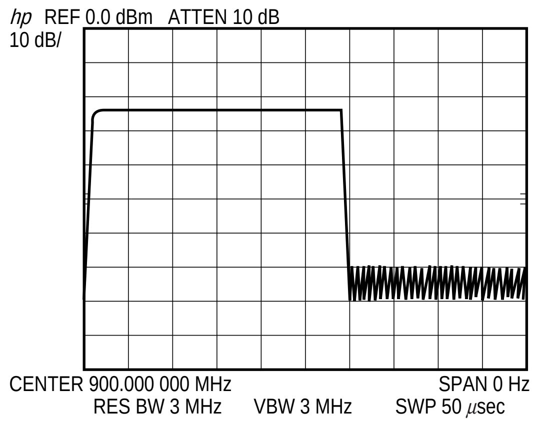
- **For 400 pF DC cut capacitor**

Rise time
T_{rise} = 6 μs
Fall time
T_{fall} = 0.5 μs



- **For 100 pF DC cut capacitor**

Rise time
T_{rise} = 2 μs
Fall time
T_{fall} = 1 μs

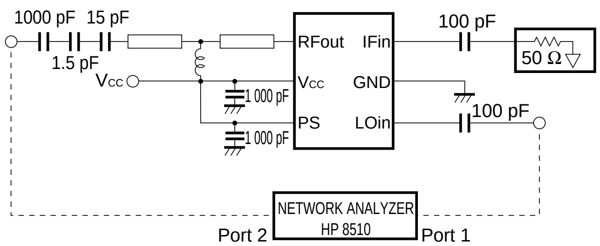


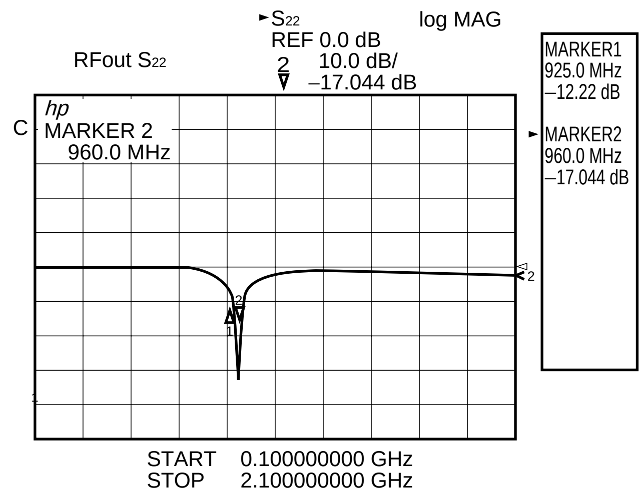
5.2 Leakage and Isolation Characteristics

As shown below, this IC's leakage and isolation characteristics were measured using circuits in which the matching adjustment and return loss have been optimized for frequency (a) or frequency (b). Figure 5-2 shows the corresponding characteristics curves. The μPC8106T and μPC8109T were used for these measurements.

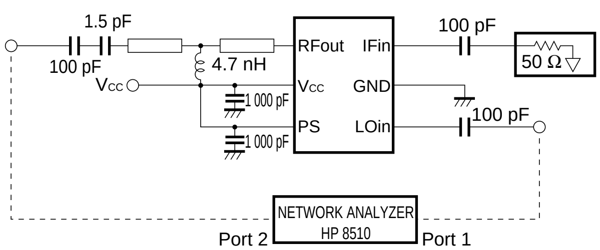
Test circuit **RF port return loss**

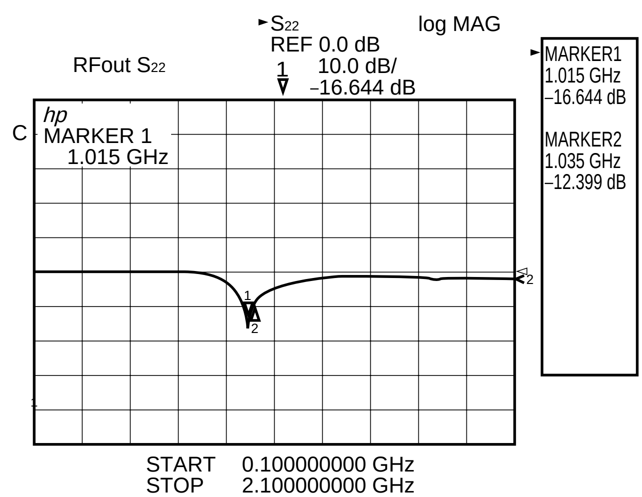
(a) f_{RFout} matched at 925 to 958 MHz





(b) f_{RFout} matched at 1 015 to 1 033 MHz





Note Connections in diagrams assume measurement of RF → LO.

Figure 5-2. Isolation Data (1/2)

(μPC8109 T_A = +25°C, V_{CC} = V_{PS} = V_{RFout} = 3.0 V)

(a) f_{RFout} matched at 925 to 958 MHz

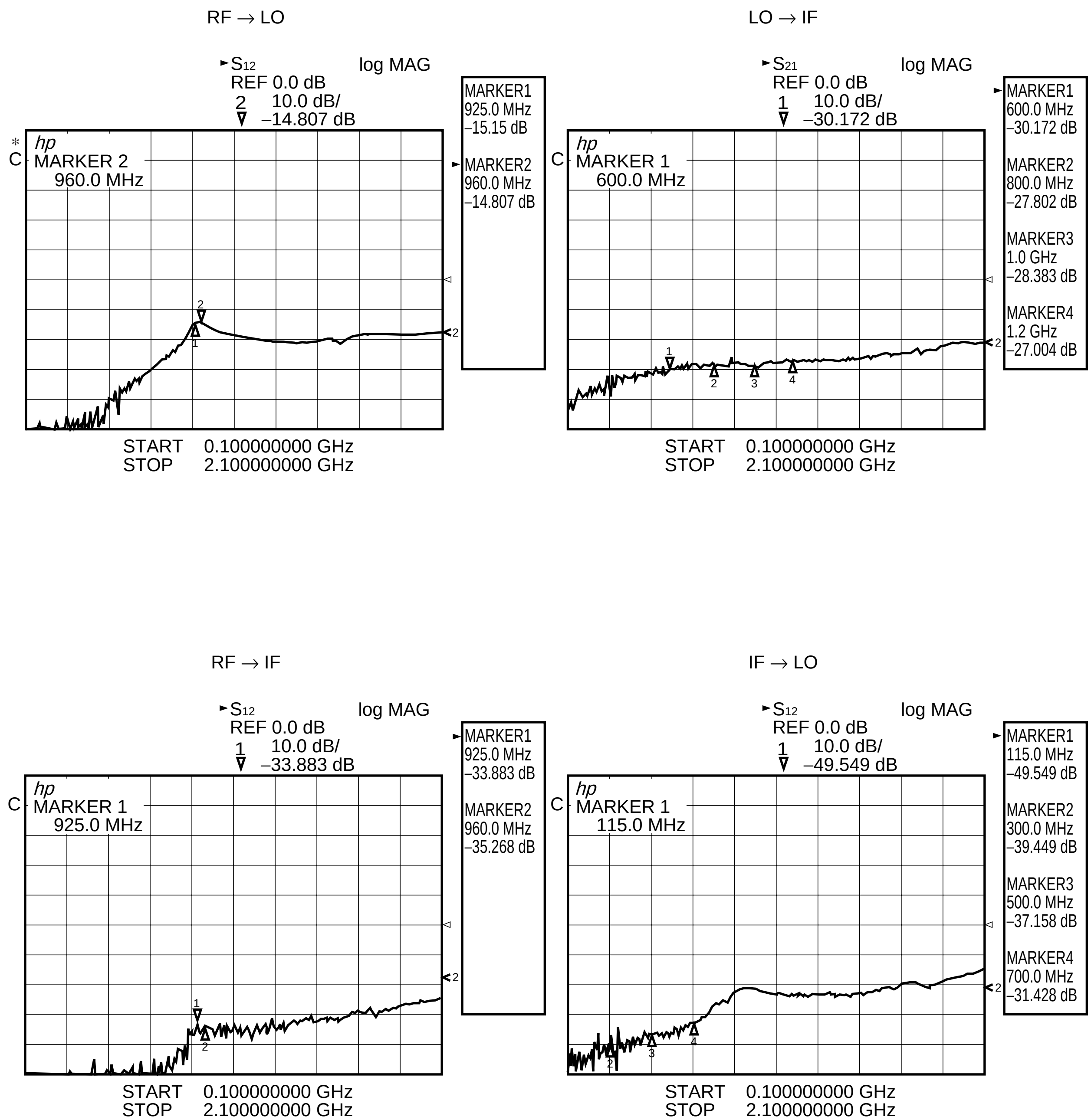
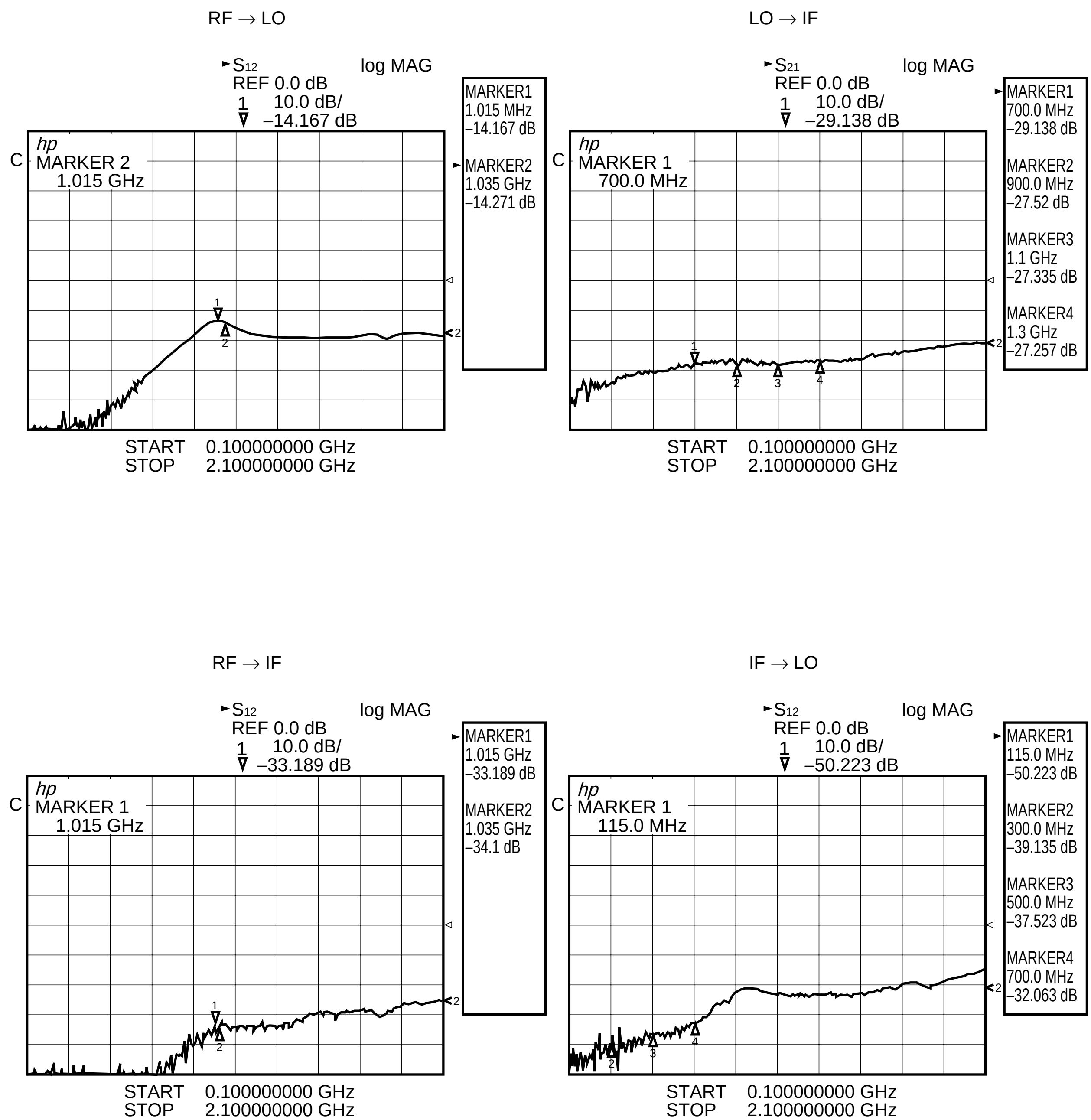


Figure 5-2. Isolation Data (2/2)

(b) f_{RFout} matched at 1 015 to 1 033 MHz



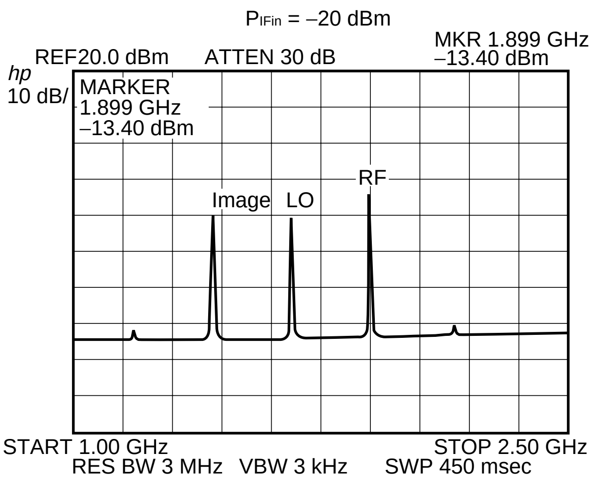
5.3 Spurious Characteristics

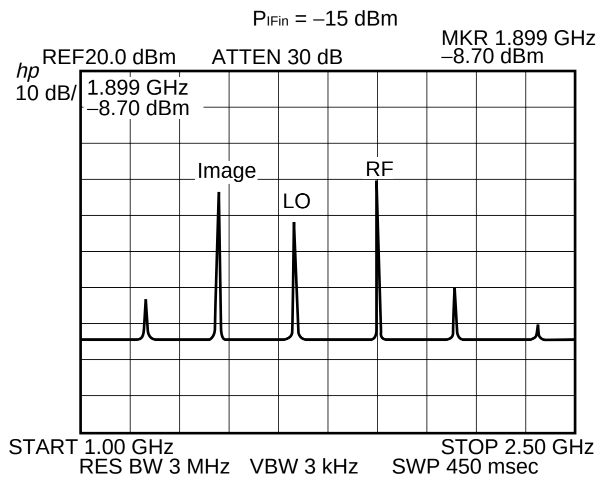
Parts (a) and (b) of Figure 5-3 show waveforms that were monitored by a spectrum analyzer to detect the LO and RF images and the corresponding harmonic spurious levels at the μPC8106's RF port.

Figure 5-3. Harmonic Spurious Data (1/3)

(a) Monitoring range: 1 GHz to 2.5 GHz

(μPC8106T Conditions: f_{RFout} = 1.9 GHz, f_{IFin} = 240 MHz, f_{LOin} = 1 660 MHz, P_{LOin} = –5 dBm, V_{CC} = V_{PS} = V_{RFout} = 3.0 V)





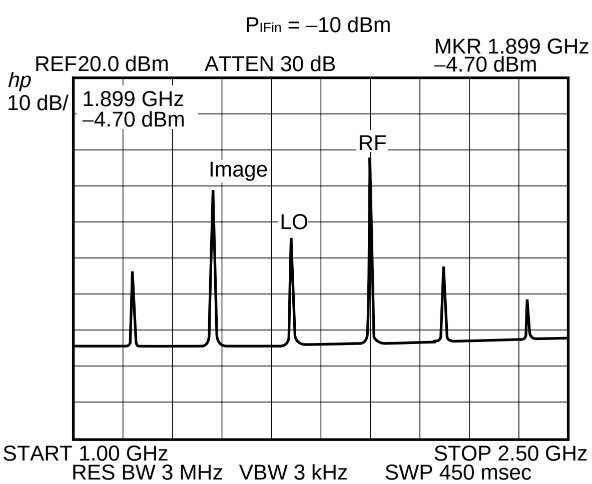
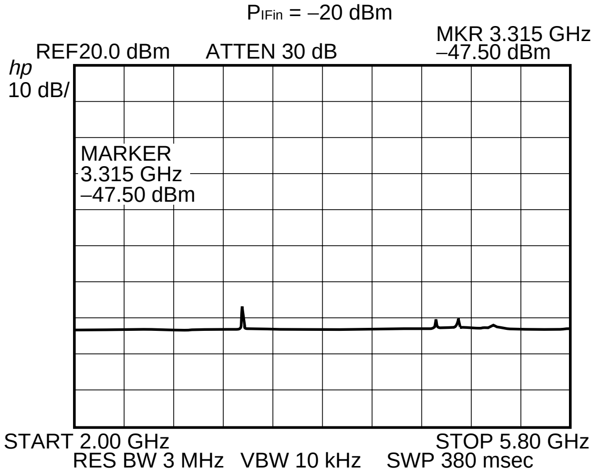


Figure 5-3. Harmonic Spurious Data (2/3)

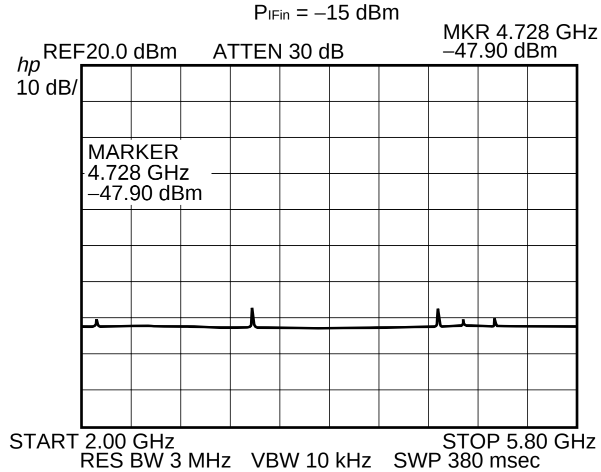
(b) Monitoring range: 2 GHz to 5.8 GHz

(μPC8106T Conditions: f_{RFout} = 1.9 GHz, f_{IFin} = 240 MHz, f_{LOin} = 1 660 MHz, P_{LOin} = –5 dBm, V_{CC} = V_{PS} = V_{RFout} = 3.0 V)

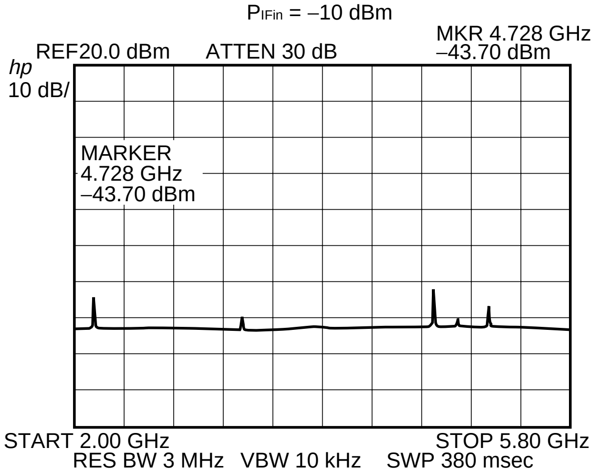
P_{IFin} = –20 dBm



P_{IFin} = –15 dBm



P_{IFin} = –10 dBm

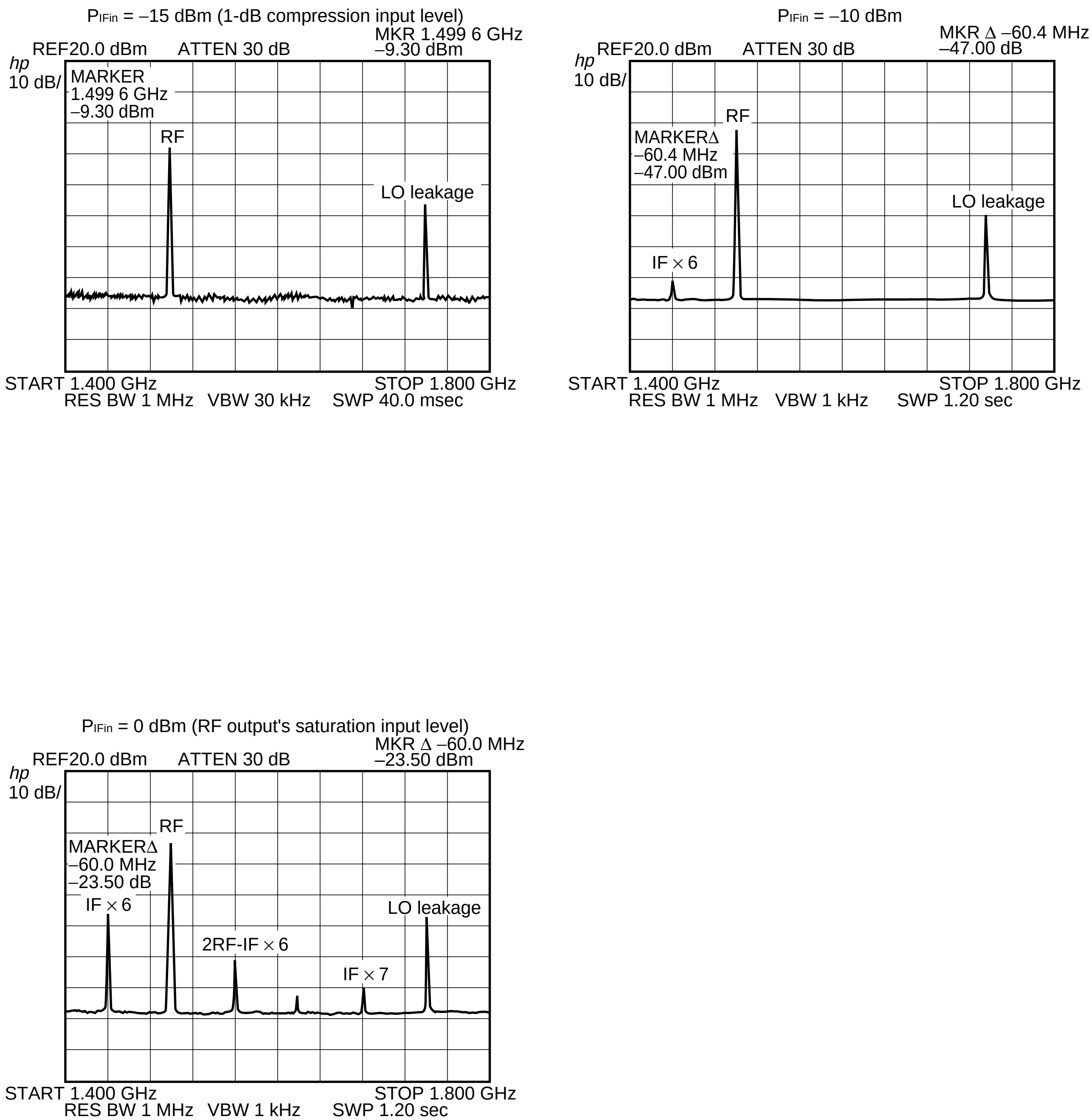


Part (c) of Figure 5-3 shows the waveforms that were monitored by a spectrum analyzer when measuring the dependence of the IF input level and the spurious IF harmonic signals at the μPC8106T's RF port. As shown in the figure, if the IF input level exceeds the 1-dB compression level, spurious IF harmonic signals may occur near the RF output. Therefore, we recommend usage within a linear region.

Figure 5-3. Harmonic Spurious Data (3/3)

(c) Monitoring range: 1.4 GHz to 1.8 GHz

(μPC8106T Conditions: f_{RFout} = 1.5 GHz, f_{IFin} = 240 MHz, f_{LOin} = 1 740 MHz, P_{LOin} = –5 dBm, V_{CC} = V_{PS} = V_{RFout} = 3.0 V)



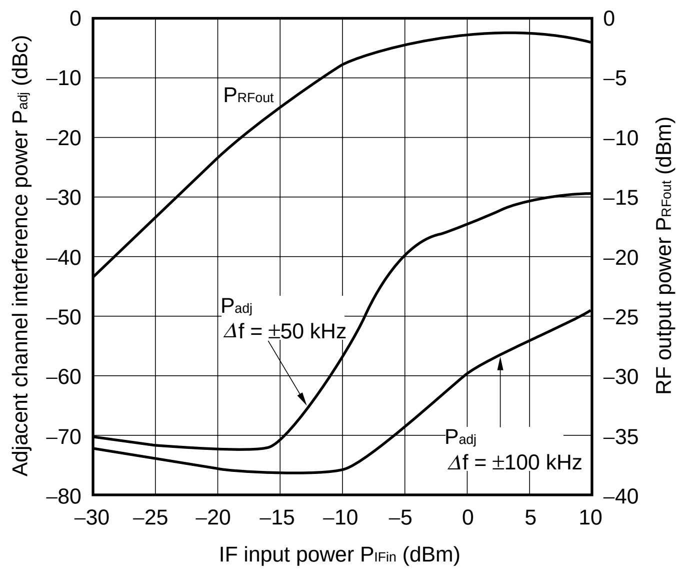
5.4 Adjacent Channel Interference Power

The adjacent channel interference power was measured under the following conditions in the μPC8106 and μPC8109: PDC800 MHz, PHS1 900 MHz, GSM900 MHz, and CDMA900 MHz, and under the following conditions in the μPC8163: PDC800 MHz, GSM900 MHz, DSC1 800 MHz, CDMA900 MHz. The resulting waveforms are shown in the Figures 5-4, 5-5, 5-6, 5-7, and 5-8.

Figure 5-4. Adjacent Channel Interference Power Characteristics in μPC8106T (1/3)

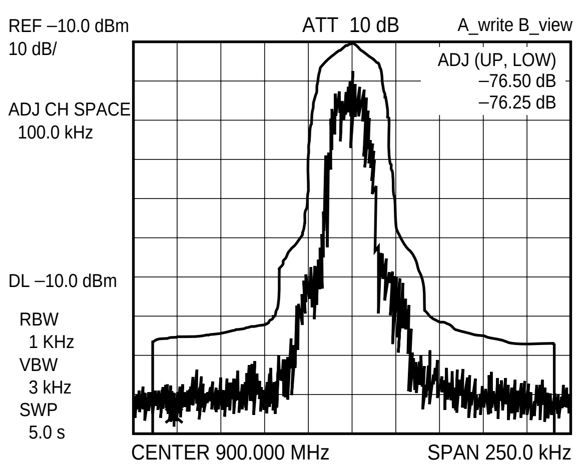
(a) RF output frequency f_{RFout} = 900 MHz
(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 42 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



f_{IFin} = 130 MHz
f_{LOin} = 1 030 MHz
P_{LOin} = –5 dBm
$V_{CC} = V_{PS} = V_{RFout}$ = 3.0 V

P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

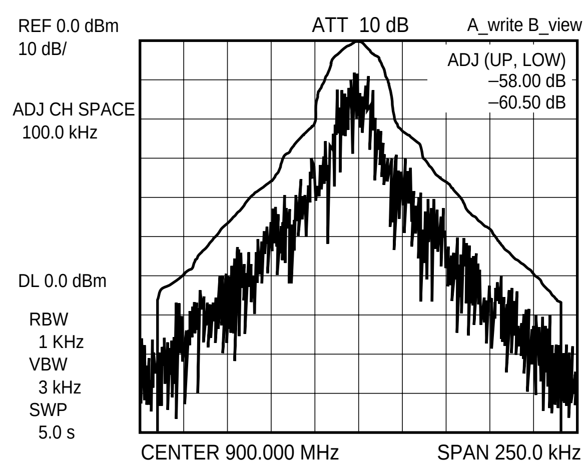
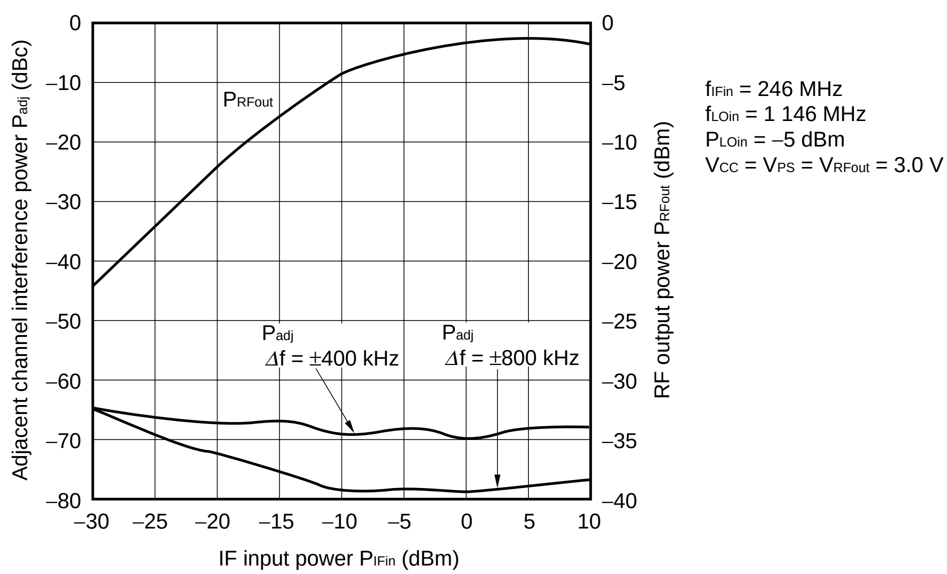


Figure 5-4. Adjacent Channel Interference Power Characteristics in μPC8106T (2/3)

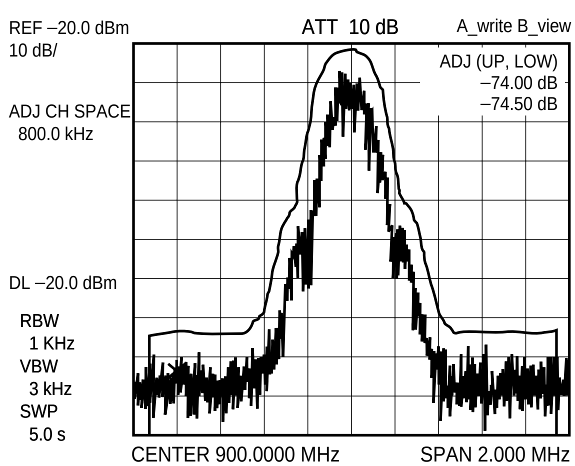
(b) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: GMSK modulated frequency input, transmission rate = 270.833 kbps, roll-off rate = 0.3, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

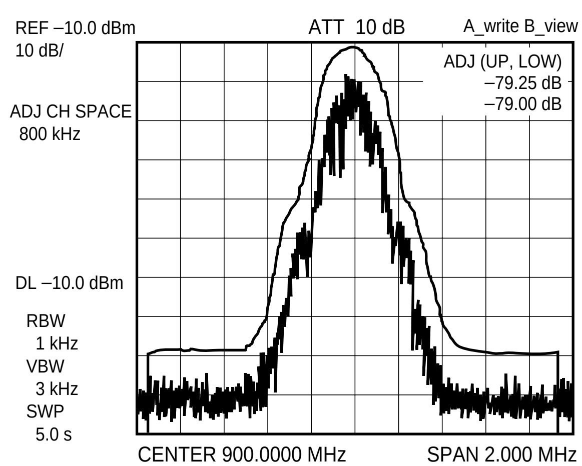
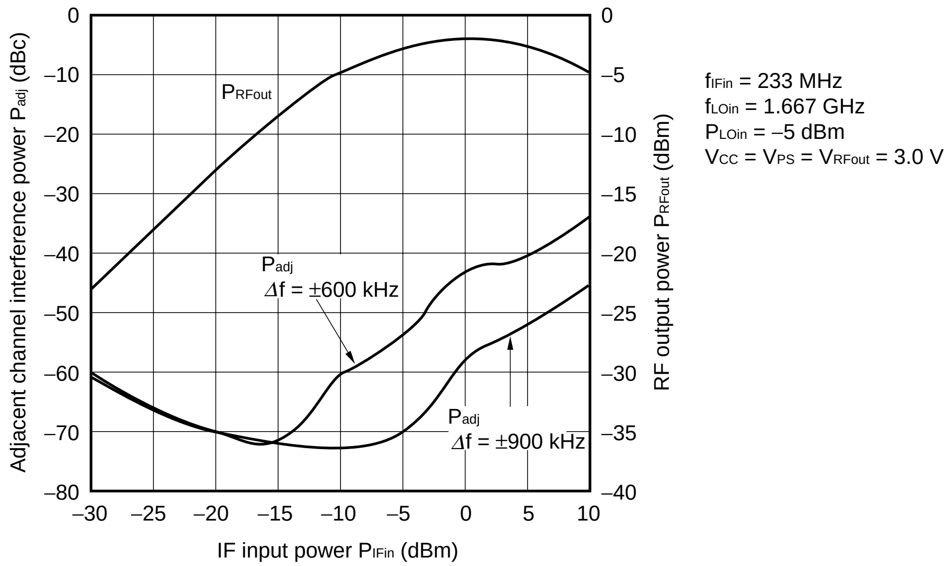


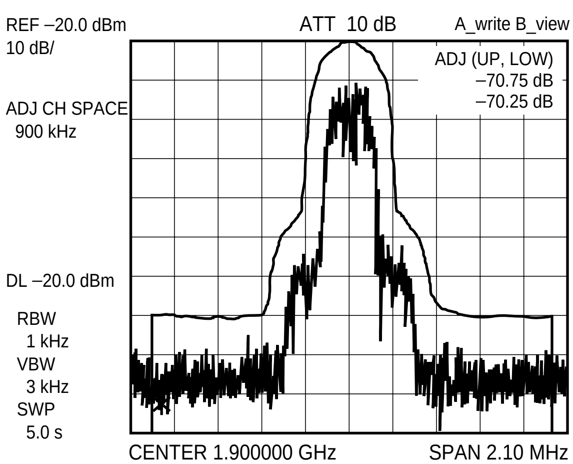
Figure 5-4. Adjacent Channel Interference Power Characteristics in μPC8106T (3/3)

(c) RF output frequency f_{RFout} = 1 900 MHz
(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 384 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

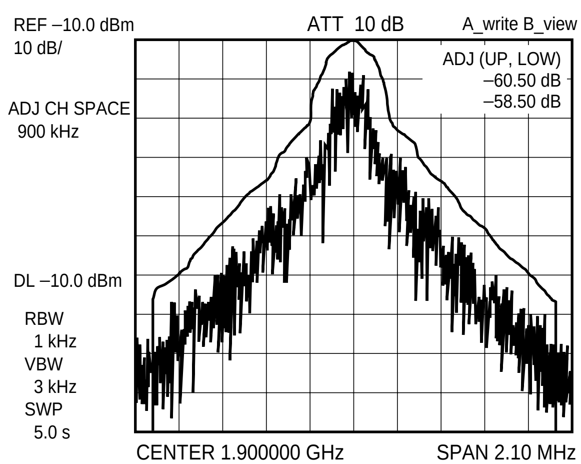
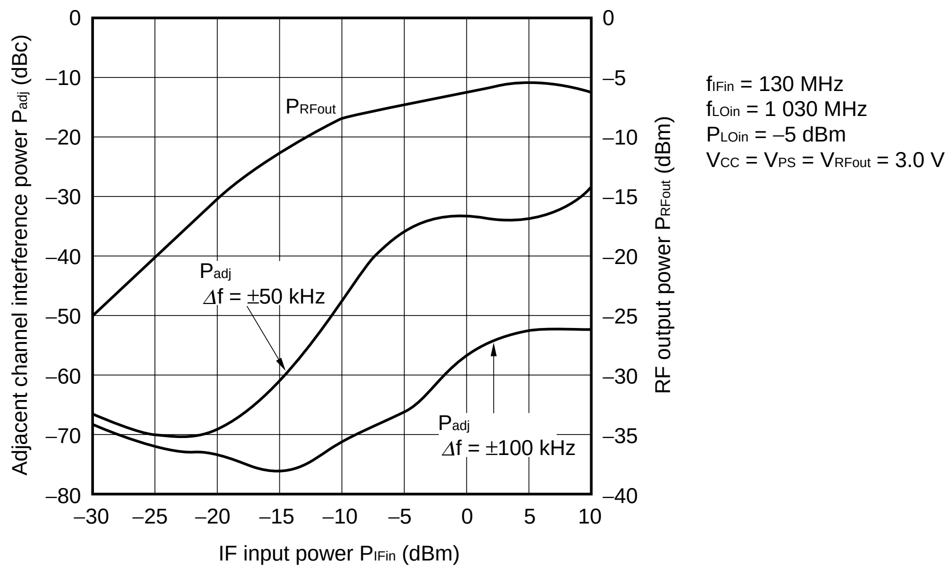


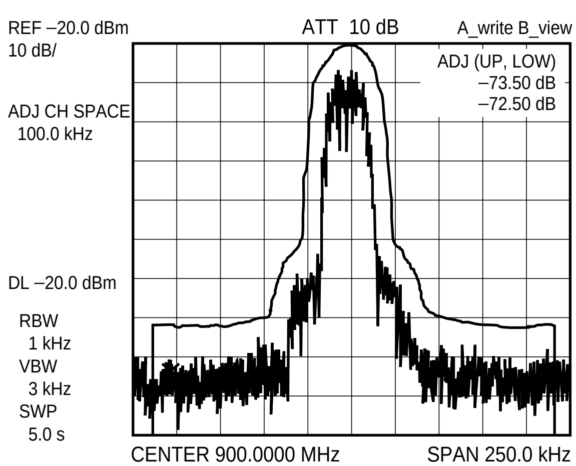
Figure 5-5. Adjacent Channel Interference Power Characteristics in μPC8109T (1/3)

(a) RF output frequency f_{RFout} = 900 MHz
(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 42 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

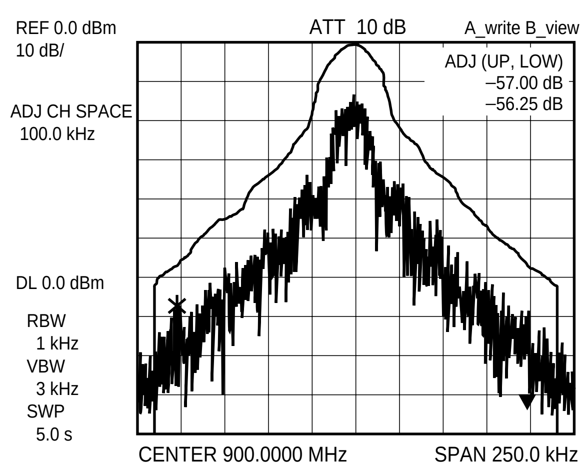
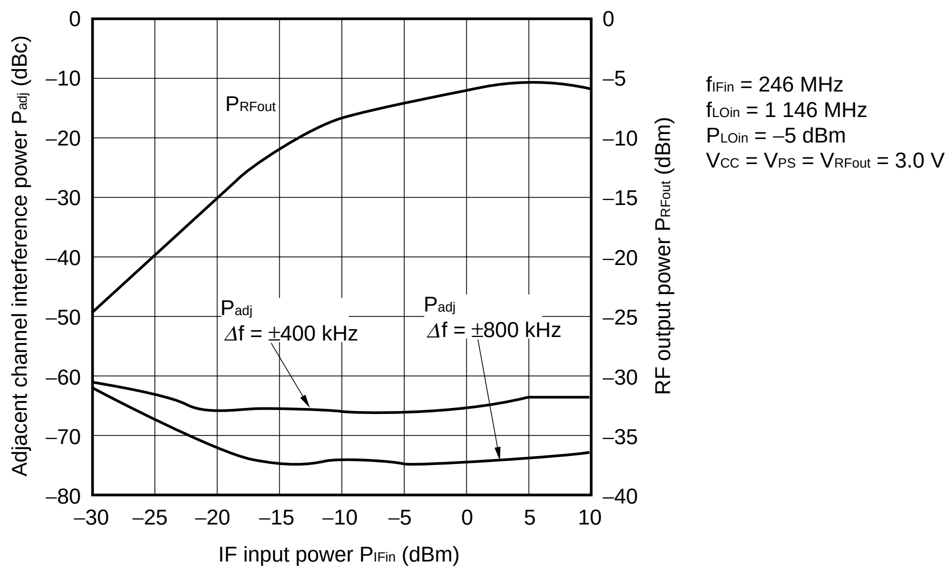


Figure 5-5. Adjacent Channel Interference Power Characteristics in μPC8109T (2/3)

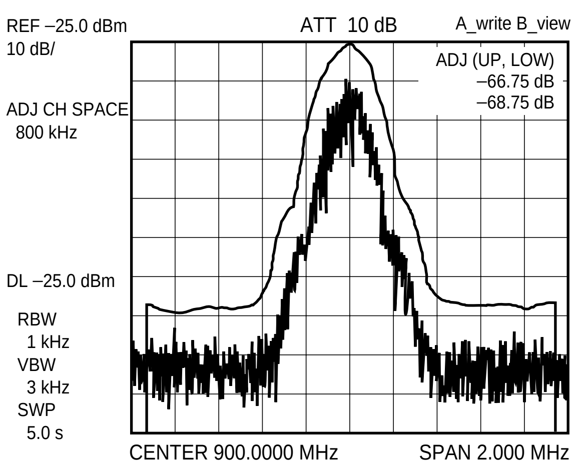
(b) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: GMSK modulated frequency input, transmission rate = 270.833 kbps, roll-off rate = 0.3, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



Padj waveform (linear region)



Padj waveform (saturation region)

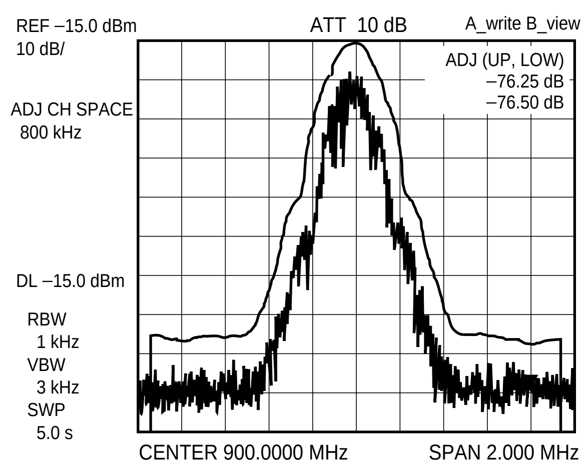
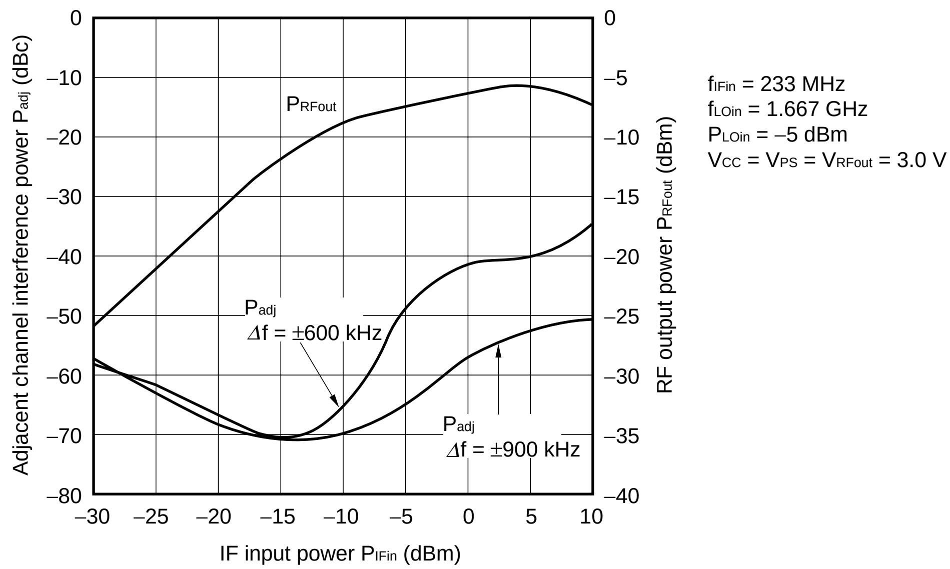


Figure 5-5. Adjacent Channel Interference Power Characteristics in μPC8109T (3/3)

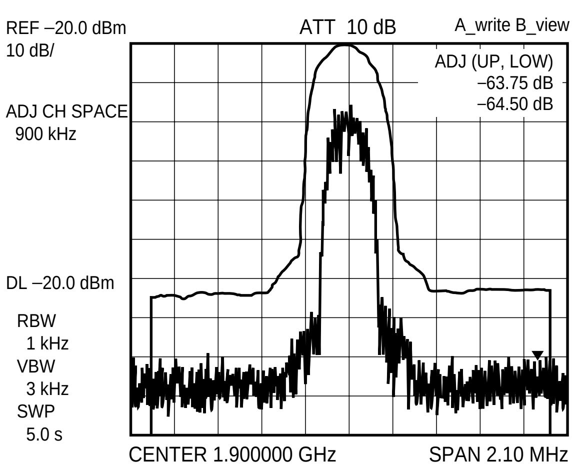
(c) RF output frequency f_{RFout} = 1 900 MHz

(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 384 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



Padj waveform (linear region)



Padj waveform (saturation region)

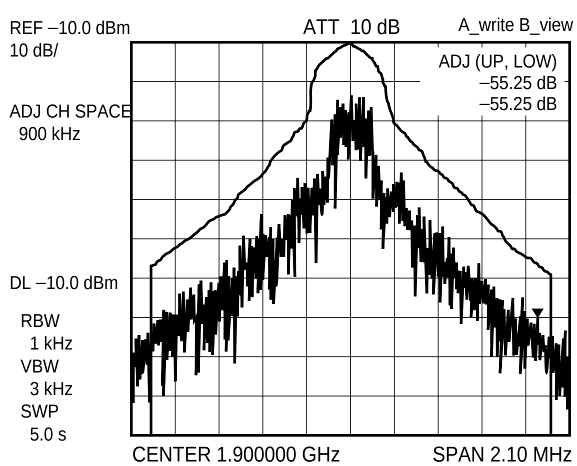
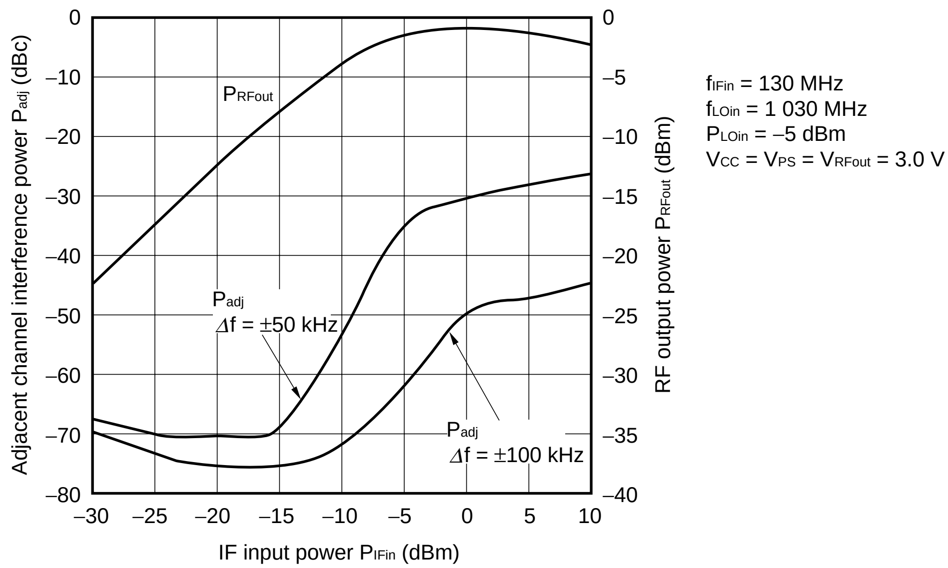


Figure 5-6. Adjacent Channel Interference Power Characteristics in μPC8106TB (1/4)

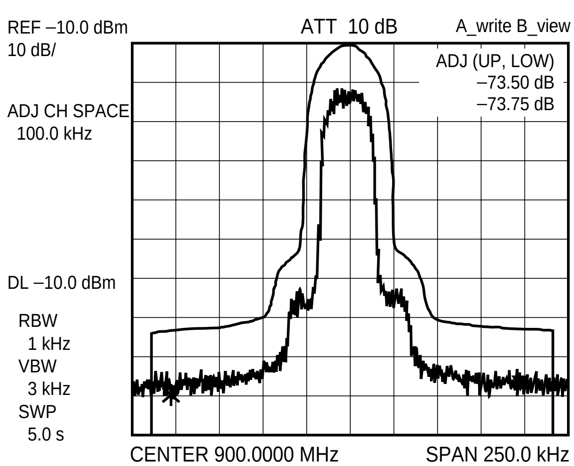
(a) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 42 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



Padj waveform (linear region)



Padj waveform (saturation region)

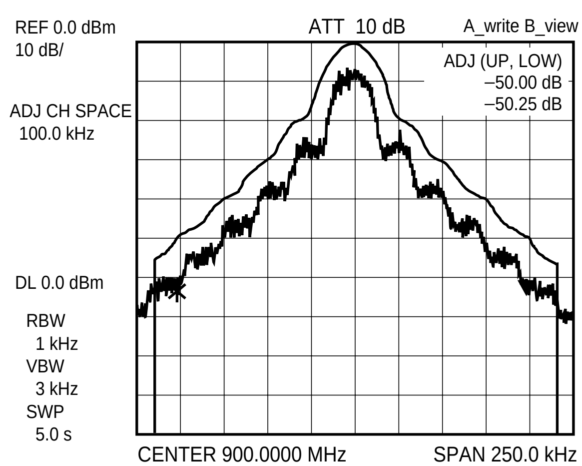
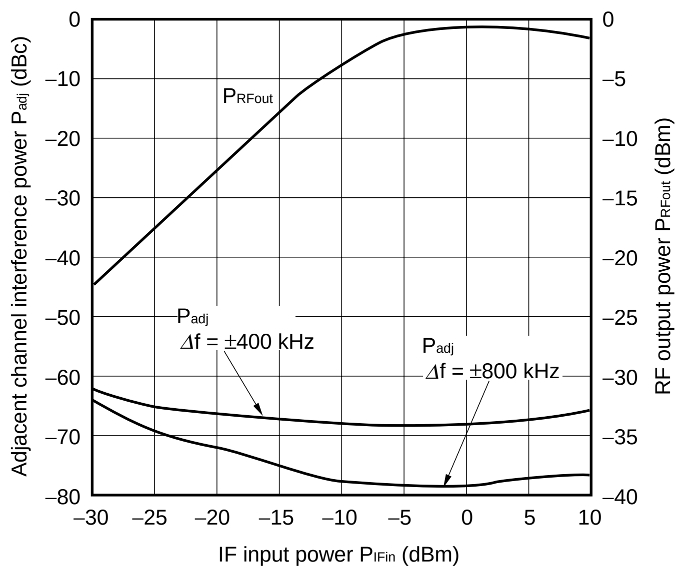


Figure 5-6. Adjacent Channel Interference Power Characteristics in μPC8106TB (2/4)

(b) RF output frequency f_{RFout} = 900 MHz

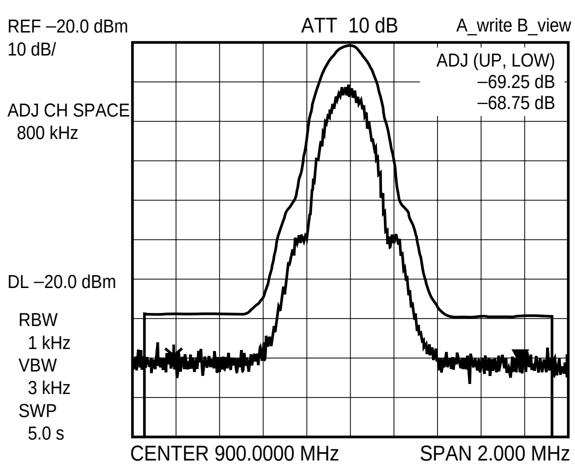
(IF input conditions: GMSK modulated frequency input, transmission rate = 270.833 kbps, roll-off rate = 0.3, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



f_{IFin} = 246 MHz
f_{LOin} = 1 146 MHz
P_{LOin} = –5 dBm
$V_{CC} = V_{PS} = V_{RFout}$ = 3.0 V

P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

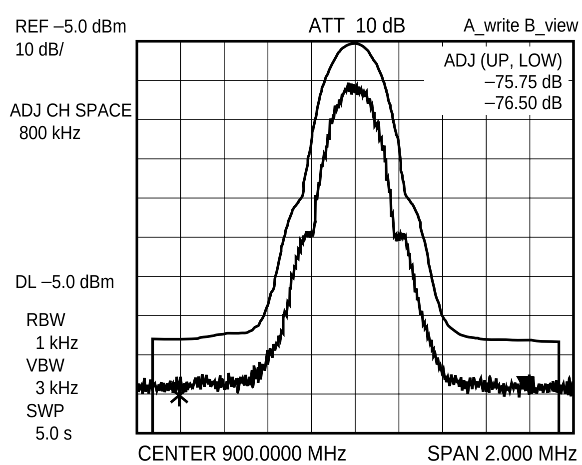
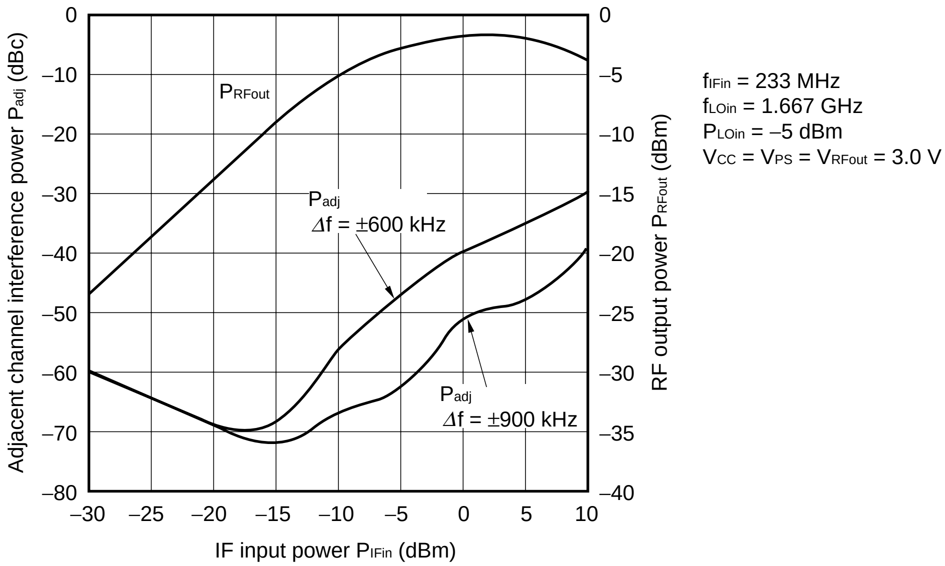


Figure 5-6. Adjacent Channel Interference Power Characteristics in μPC8106TB (3/4)

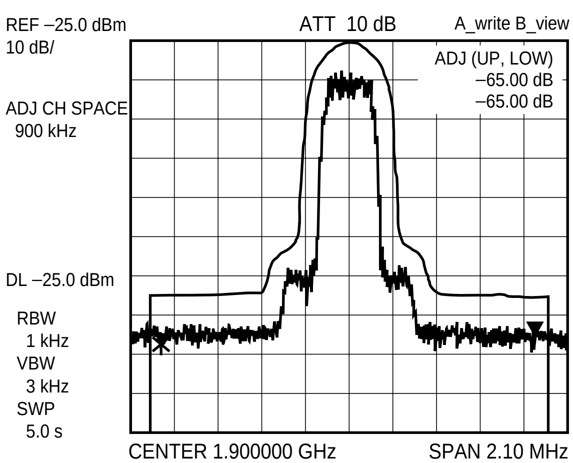
(c) RF output frequency f_{RFout} = 1 900 MHz

(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 384 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

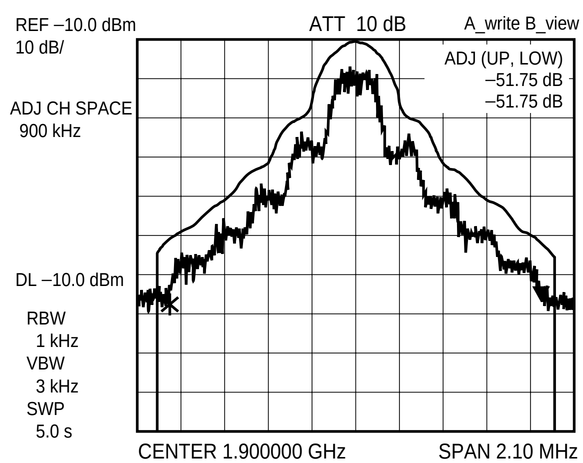
Adjacent channel interference power and RF output power vs. IF input power



Padj waveform (linear region)



Padj waveform (saturation region)

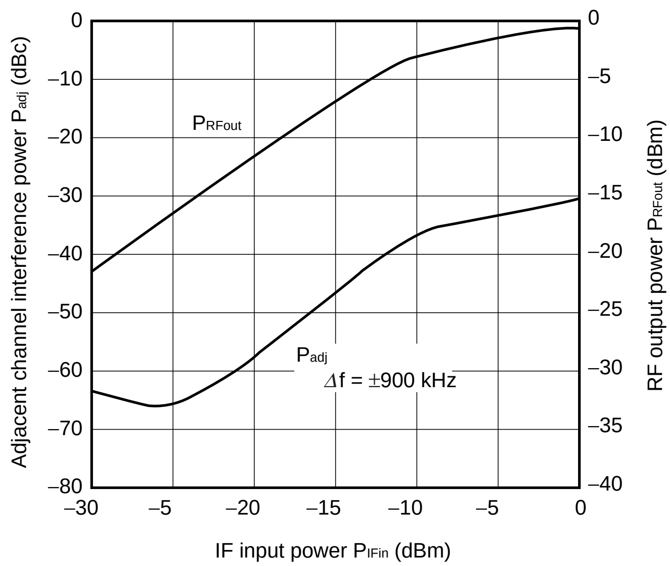


★ **Figure 5-6. Adjacent Channel Interference Characteristics in μPC8106TB (4/4)**

(d) RF output frequency f_{RFout} = 900 MHz

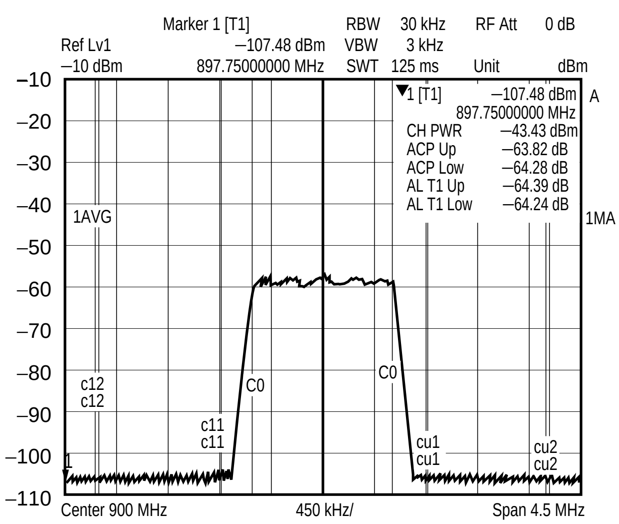
(IF input conditions: OQPSK modulated frequency (IS-95) input, transmission rate = 1.2288 MCPS, roll-off rate = 0.2)

Adjacent channel interference power and RF output power vs. IF input power



f_{IFin} = 240 MHz
f_{LOin} = 1 140 MHz
P_{LOin} = –5 dBm
V_{CC} = V_{PS} = V_{RFout} = 3.0 V

P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

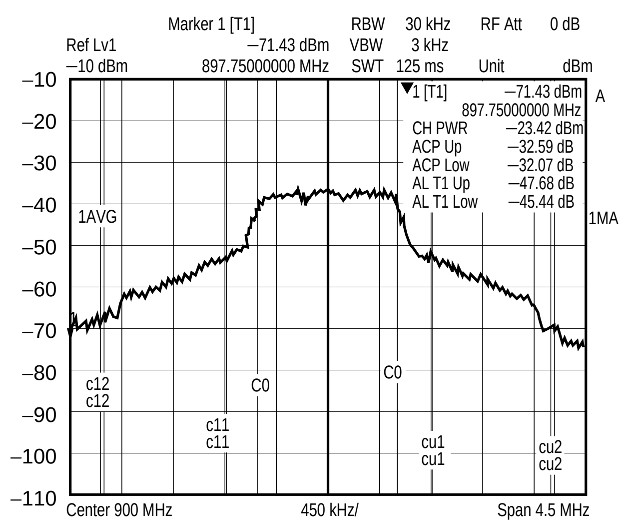
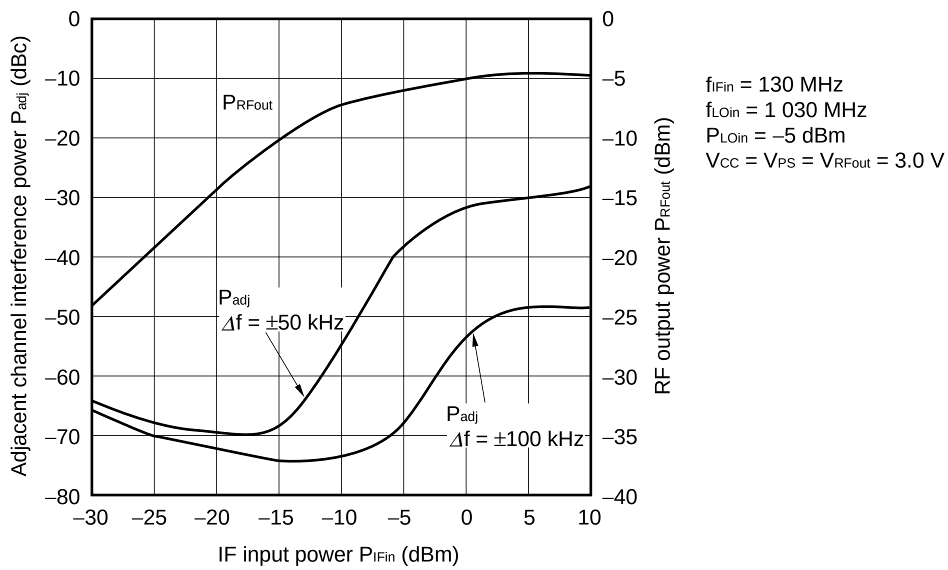


Figure 5-7. Adjacent Channel Interference Power Characteristics in μPC8109TB (1/4)

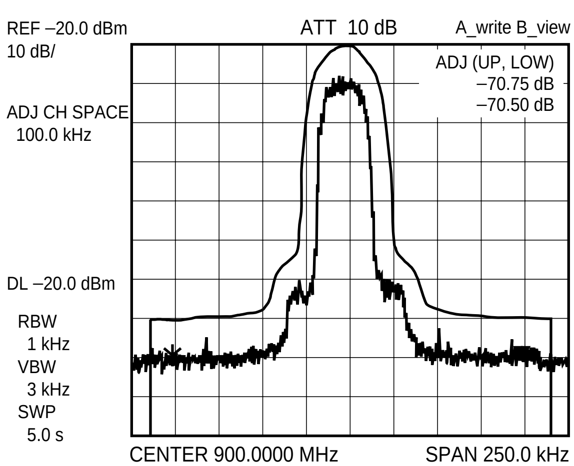
(a) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 42 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



Padj waveform (linear region)



Padj waveform (saturation region)

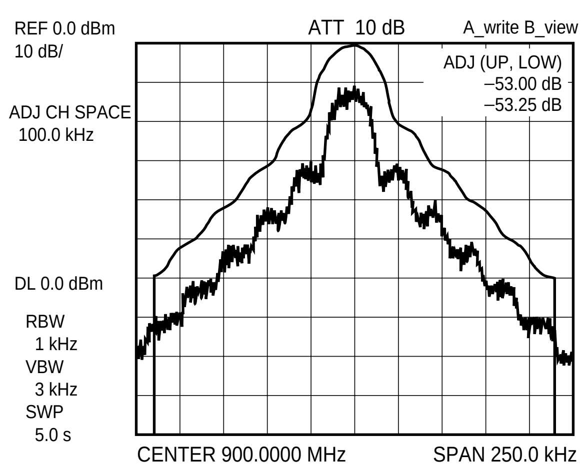
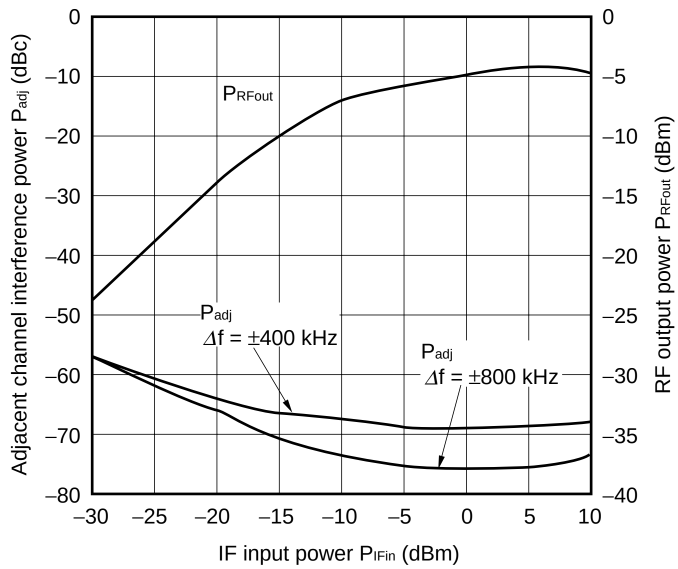


Figure 5-7. Adjacent Channel Interference Power Characteristics in μPC8109TB (2/4)

(b) RF output frequency f_{RFout} = 900 MHz

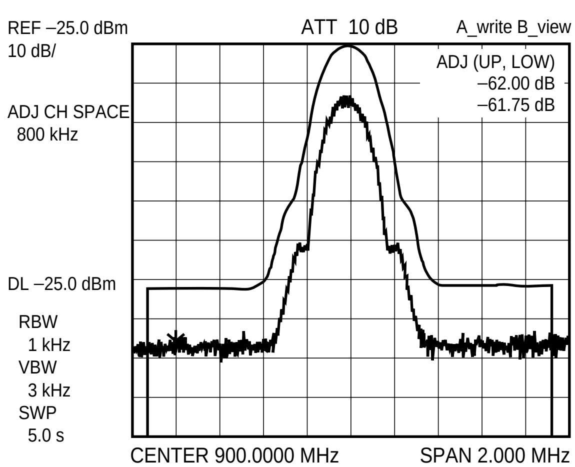
(IF input conditions: GMSK modulated frequency input, transmission rate = 270.833 kbps, roll-off rate = 0.3, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power



f_{IFin} = 246 MHz
f_{LOin} = 1 146 MHz
P_{LOin} = –5 dBm
V_{CC} = V_{PS} = V_{RFout} = 3.0 V

P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

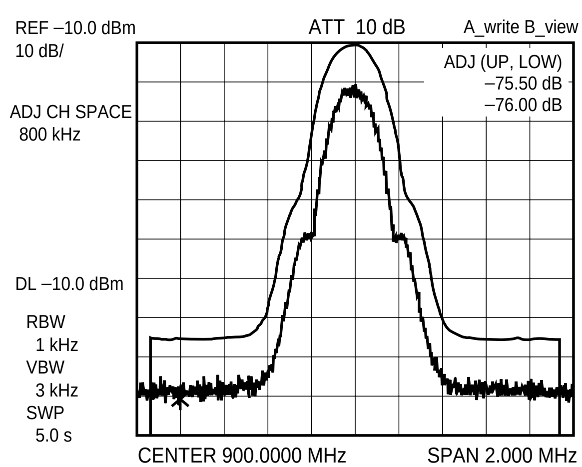
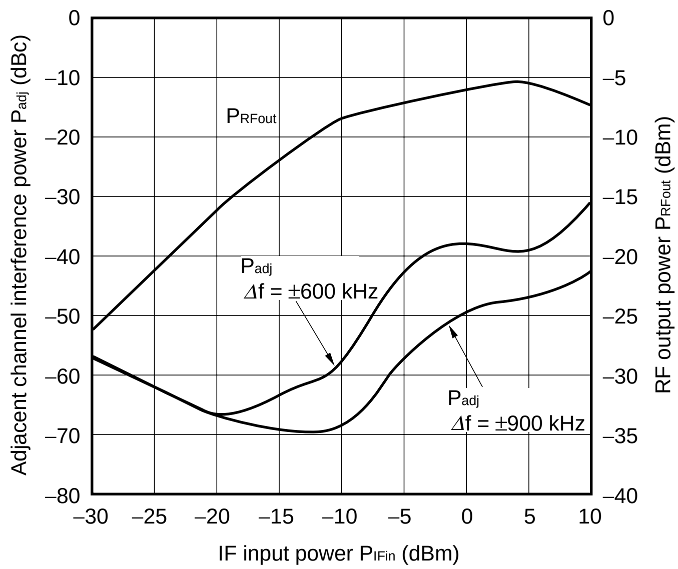


Figure 5-7. Adjacent Channel Interference Power Characteristics in μPC8109TB (3/4)

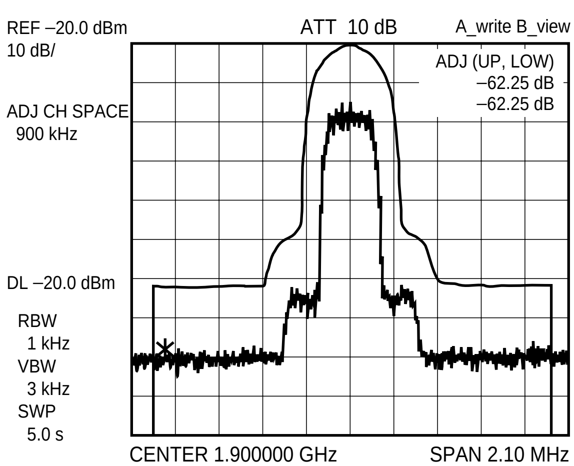
(c) RF output frequency f_{RFout} = 1 900 MHz
(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 384 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

Adjacent channel interference power and RF output power vs. IF input power

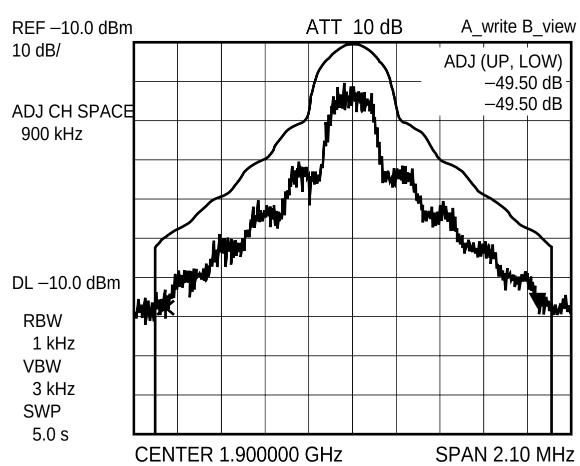


f_{IFin} = 233 MHz
f_{LOin} = 1.667 GHz
P_{LOin} = −5 dBm
V_{CC} = V_{PS} = V_{RFout} = 3.0 V

P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

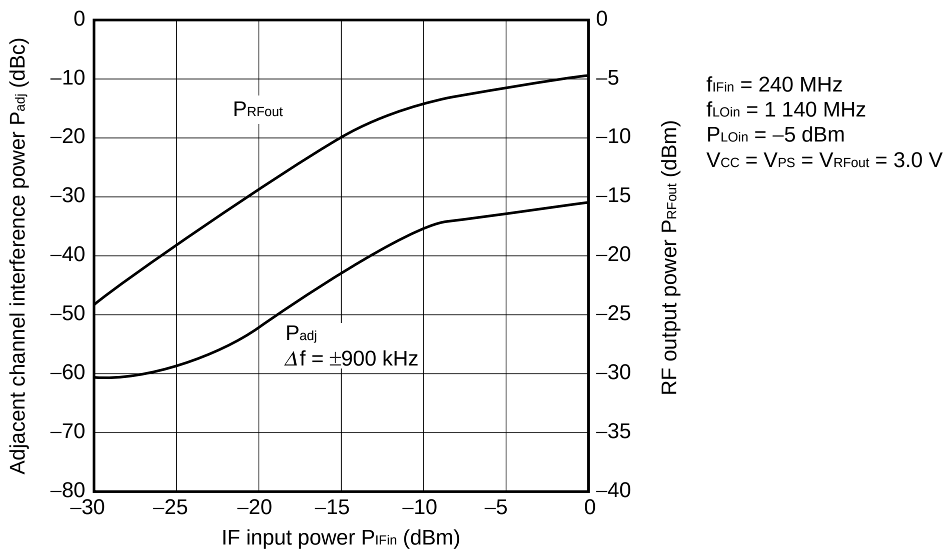


★ **Figure 5-7. Adjacent Channel Interference Characteristics in μPC8109TB (4/4)**

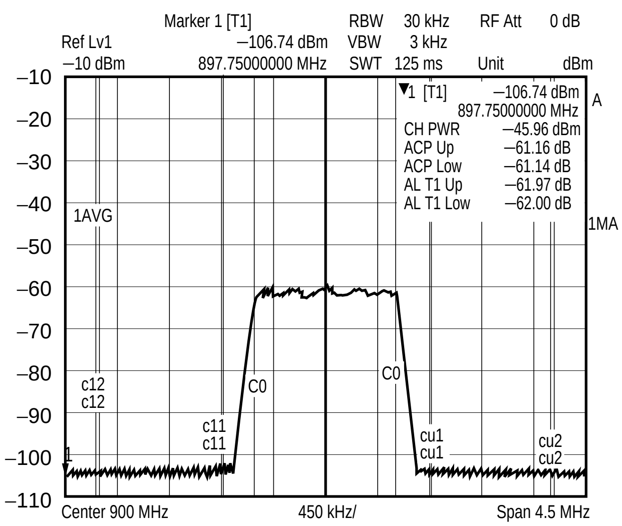
(d) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: OQPSK modulated frequency (IS-95) input, transmission rate = 1.2288 MCPS, roll-off rate = 0.2)

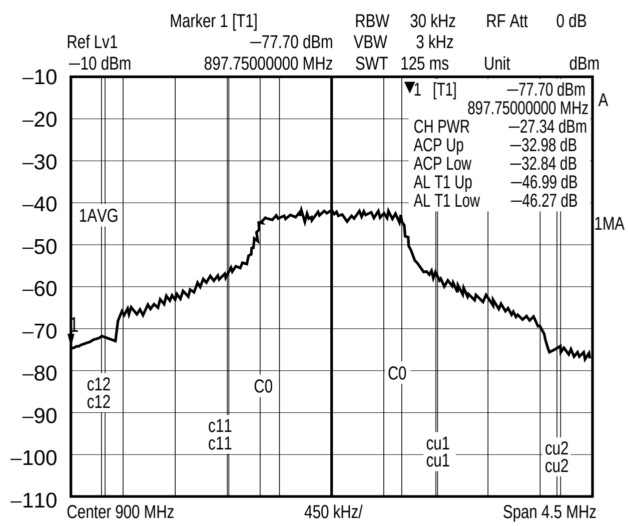
Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



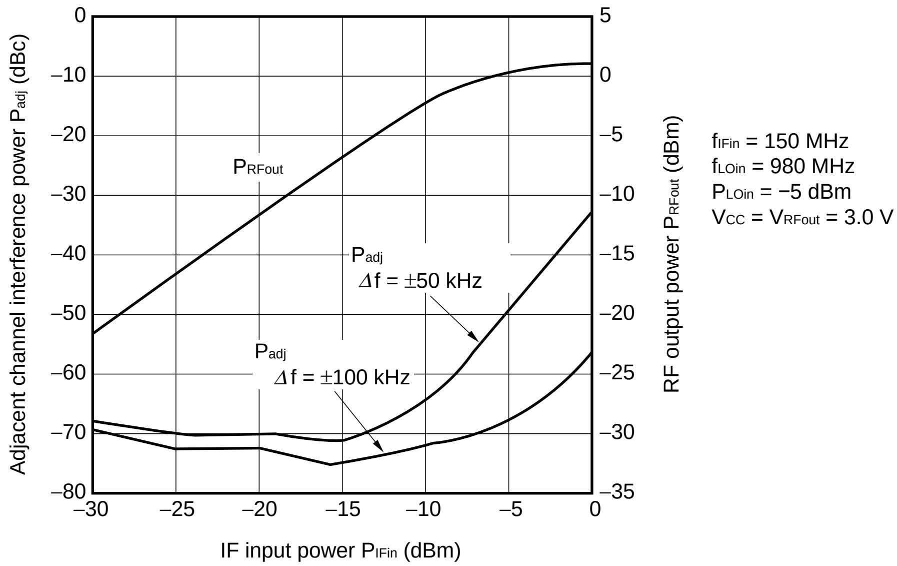
P_{adj} waveform (saturation region)



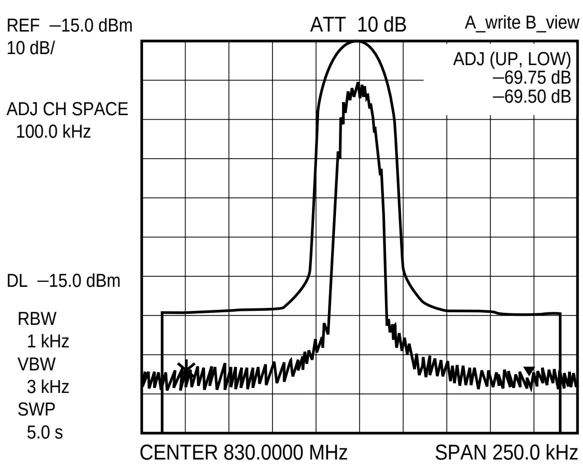
★ **Figure 5-8. Adjacent Channel Interference Characteristics in μPC8163TB (1/4)**

(a) RF output frequency f_{RFout} = 900 MHz
(IF input conditions: π/4QPSK modulated frequency input, transmission rate = 42 kbps, roll-off rate = 0.5, PN9 stage [dummy random pattern])

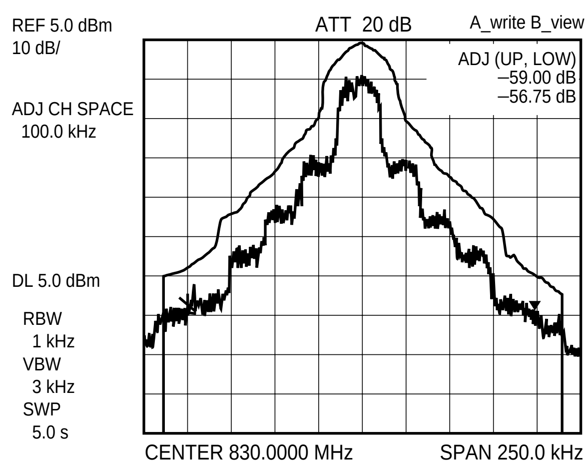
Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

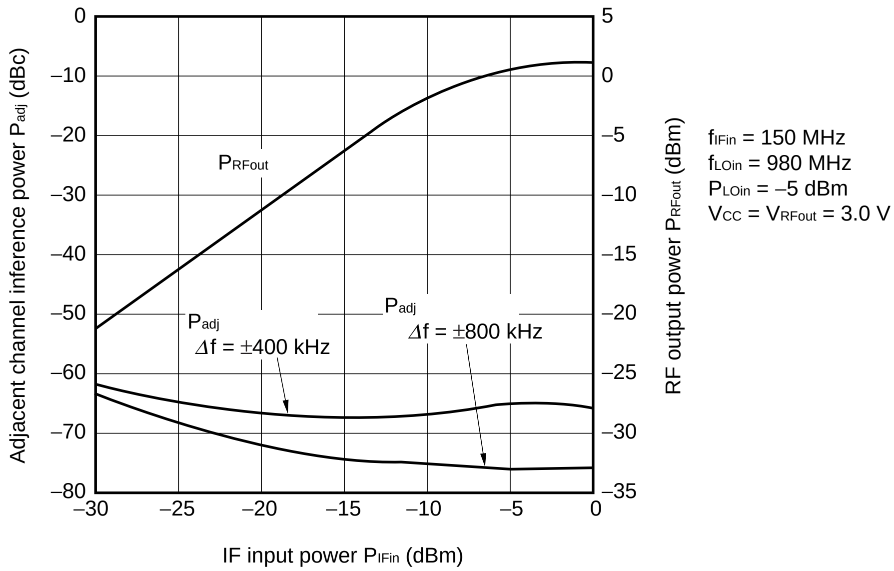


★ **Figure 5-8. Adjacent Channel Interference Characteristics in μPC8163TB (2/4)**

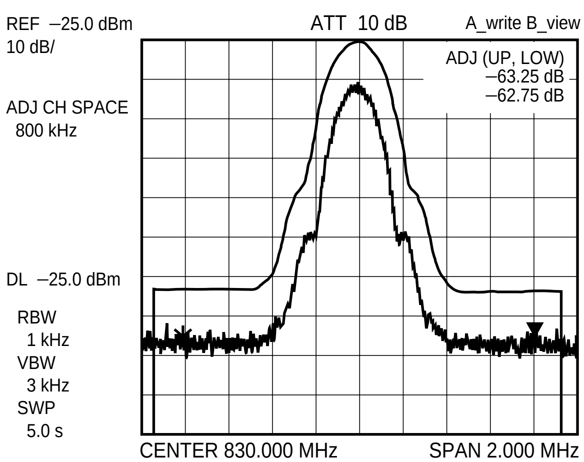
(b) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: GMSK modulated frequency input, transmission rate = 270.833 kbps, roll-off rate = 0.3, PN9 stage [dummy random pattern])

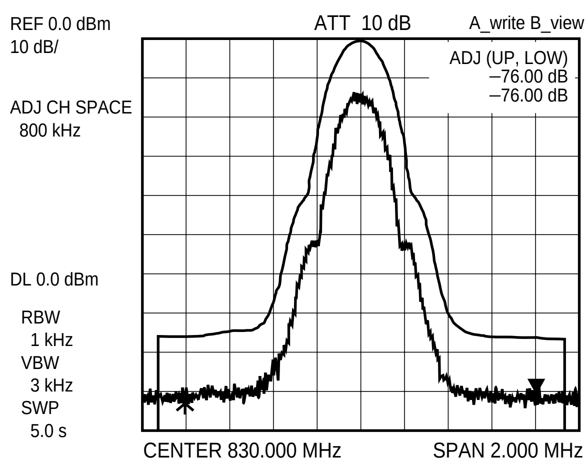
Adjacent channel interface power and RF output power vs. IF input power



Padj waveform (linear region)



Padj waveform (saturation region)

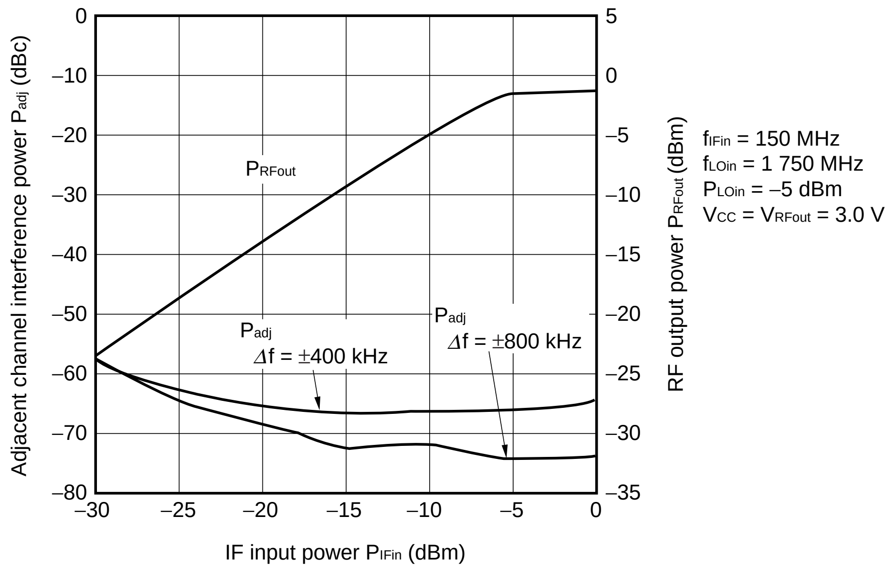


★ **Figure 5-8. Adjacent Channel Interference Characteristics in μPC8163TB (3/4)**

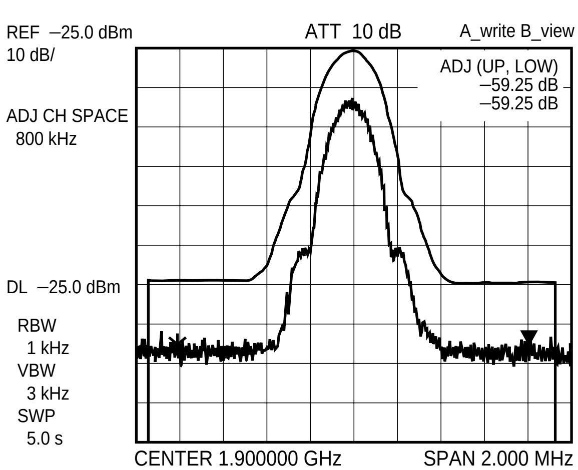
(c) RF output frequency f_{RFout} = 1 900 MHz

(IF input conditions: GMSK modulated frequency input, transmission rate = 270.833 kbps, roll-off rate = 0.3, PN9 stage [dummy random pattern])

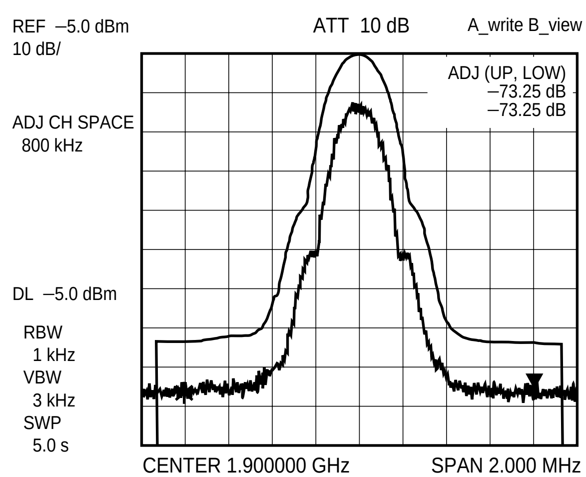
Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

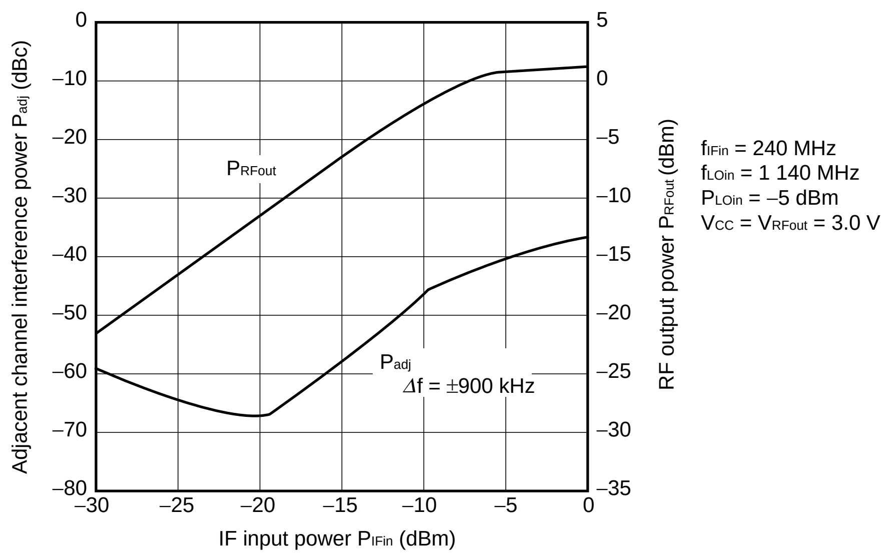


★ **Figure 5-8. Adjacent Channel Interference Characteristics in μPC8163TB (4/4)**

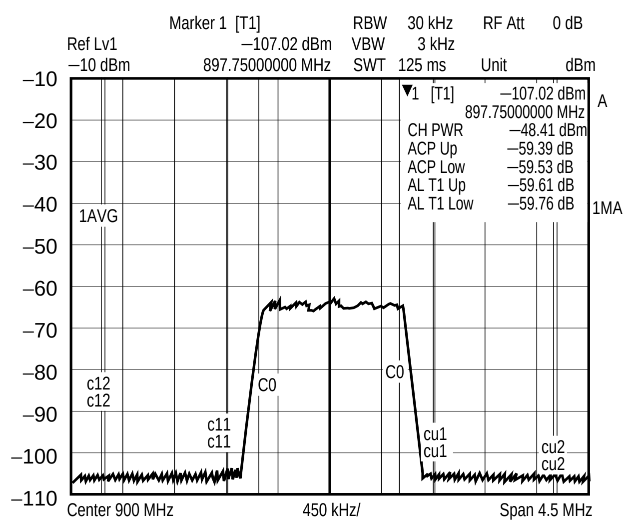
(d) RF output frequency f_{RFout} = 900 MHz

(IF input conditions: OQPSK modulated frequency (IS-95) input, transmission rate = 1.2288 MCPS, roll-off rate = 0.2)

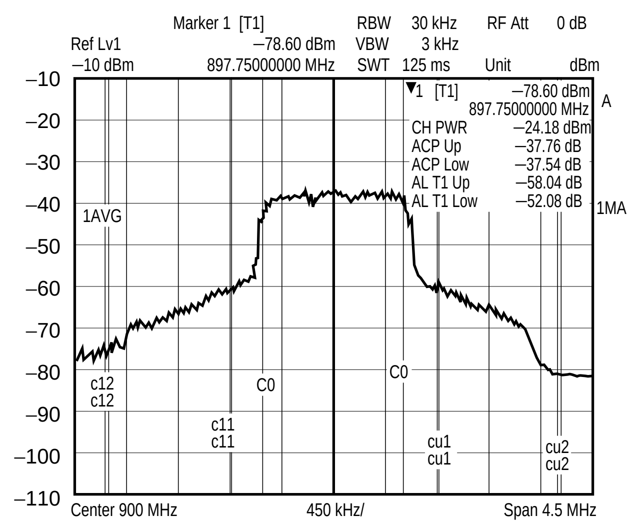
Adjacent channel interference power and RF output power vs. IF input power



P_{adj} waveform (linear region)



P_{adj} waveform (saturation region)

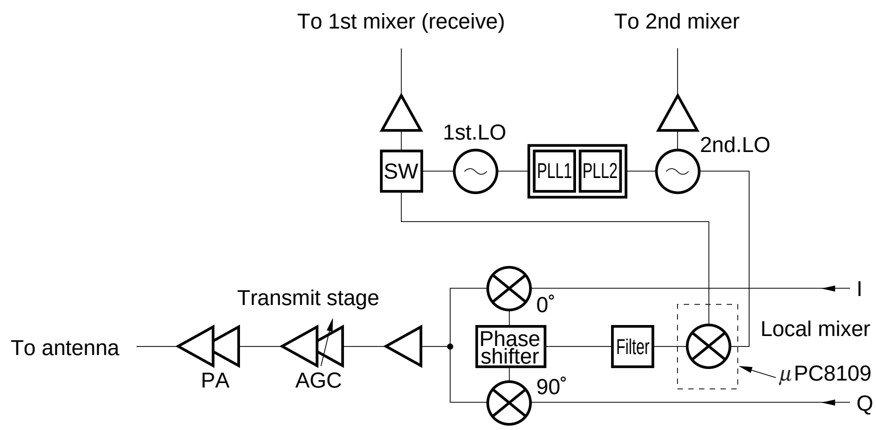


6. SYSTEM CONFIGURATION EXAMPLES

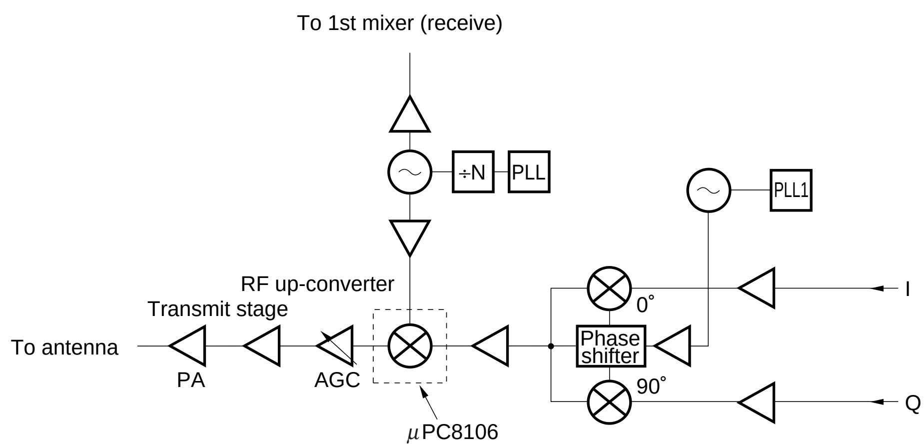
Two examples of system applications of these ICs are shown in Figure 6-1: one is the direct modulation method, which modulates at the transmit RF stage and the other is the indirect modulation method, which modulates at the transmit IF stage. The μPC8109 is suitable as a local mixer for direct modulation because of its low current consumption. The μPC8106 is suitable as an RF up-converter for indirect modulation because of its low distortion.

Figure 6-1. System Configuration Examples

(a) Direct modulation method



(b) Indirect modulation method

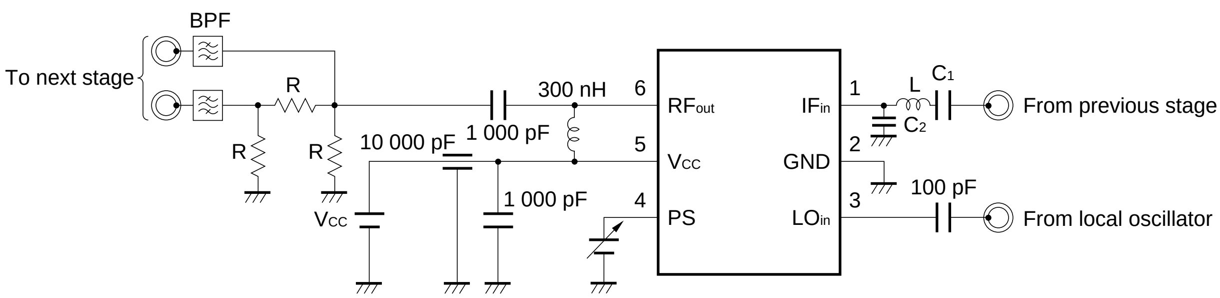


7. APPLICATION CIRCUIT EXAMPLE

7.1 Dual Band

For mobile phones that use two frequency bandwidths as transmit frequency bands, matching is required for both frequency bands, which makes it difficult to implement with just one matching circuit constant. Figure 7-1 shows an application circuit example that enables use of dual bands: inductance load is used to obtain broad-band gain and a 50 Ω pad is inserted to apply 50 Ω impedance to the next stage obtain broad-band gain. Various other application circuits can be conceived as user-side solutions.

Figure 7-1. Dual Band Circuit Configuration Example



8. CONCLUSION

This application note has briefly described the usage and application of frequency up-converter ICs for mobile communication devices. For the future, we are working to develop new core products in which the functions are improved and the integration intensified by using a new process to improve linearity and by providing support for high frequency applications.

References

μPC8106, μPC8109 and μPC8163 data sheets (see the document numbers listed in the Contents).
Also, see other reference materials that describe double balanced mixers.

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