

RFFC507x Application Note

Mixer Performance Above 4GHz

Introduction

The RFFC5071 and RFFC5072 are wideband frequency conversion devices that integrate a fractional-N synthesizer and one or two RF mixers. The mixer ports are very wideband and cover from 30MHz to 6000MHz, enabling up or down conversion.

The RFFC5071/5072 datasheet contains test results for the RF mixers up to frequencies of 4GHz. This application note presents further test results for frequencies above 4GHz. The application circuits used on the mixer ports for these measurements are also shown.

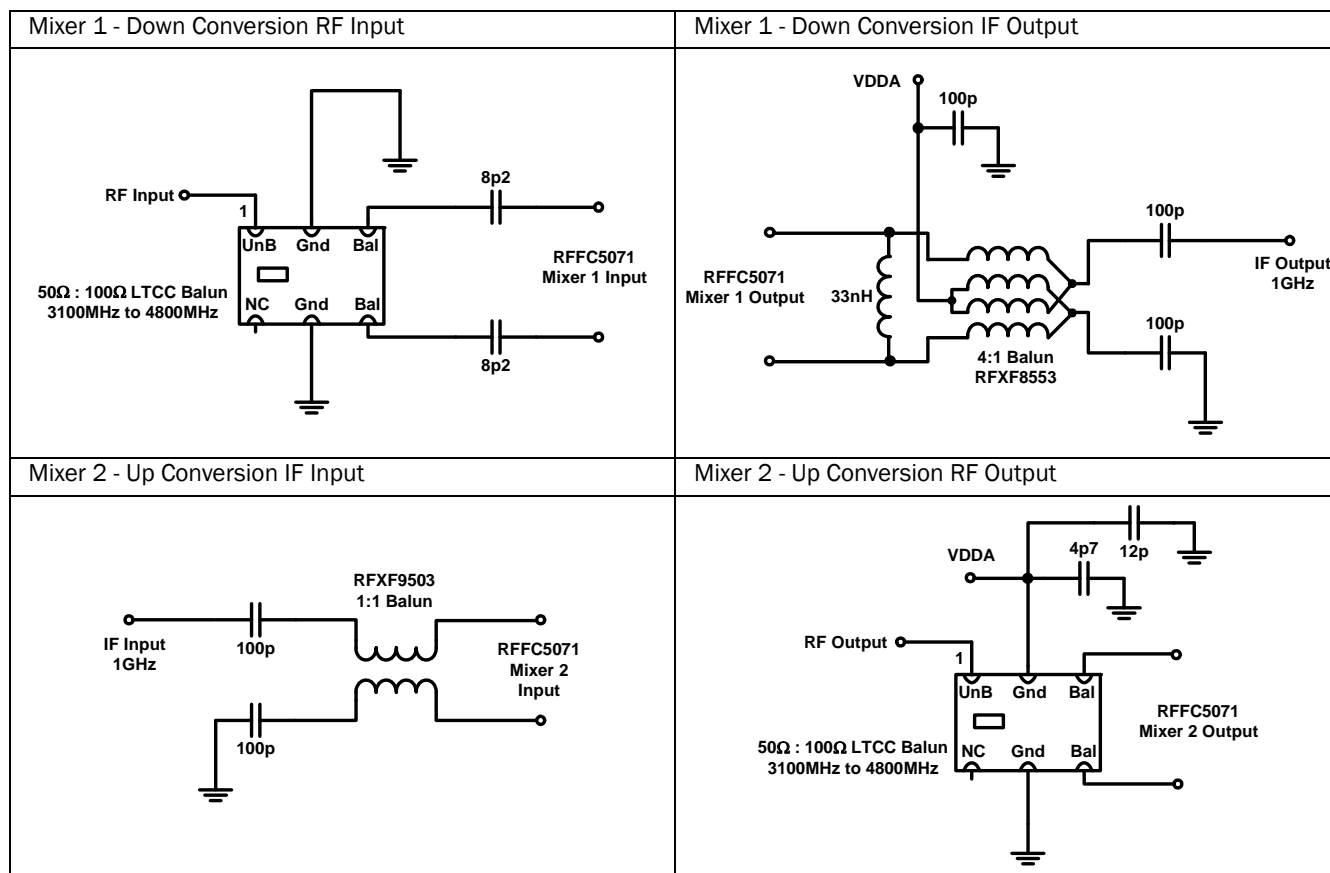
RF Frequency Range 3100 MHz to 4800 MHz

The following ceramic hybrid balun was used on the RF ports of the mixer:

Johanson Technology, 4000BL14U100, 50Ω to 100Ω, 3100MHz to 4800MHz

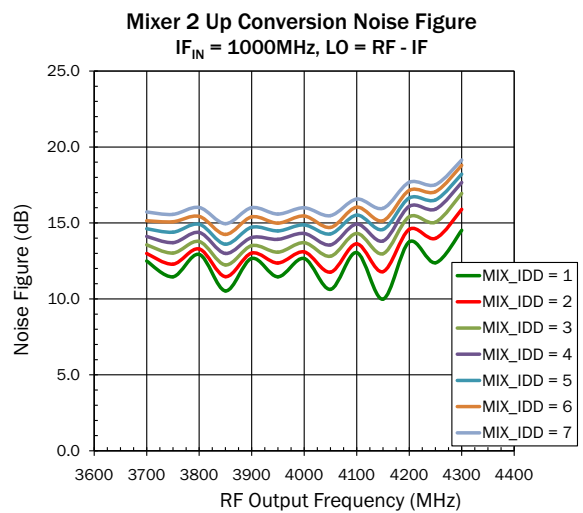
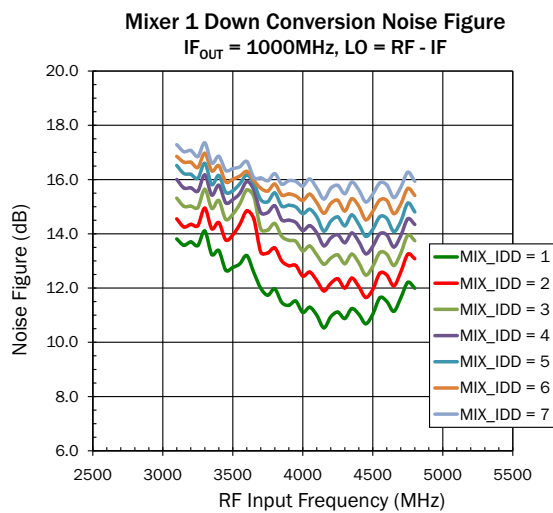
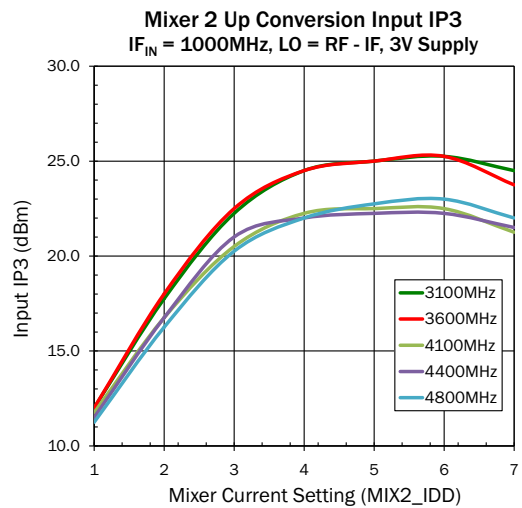
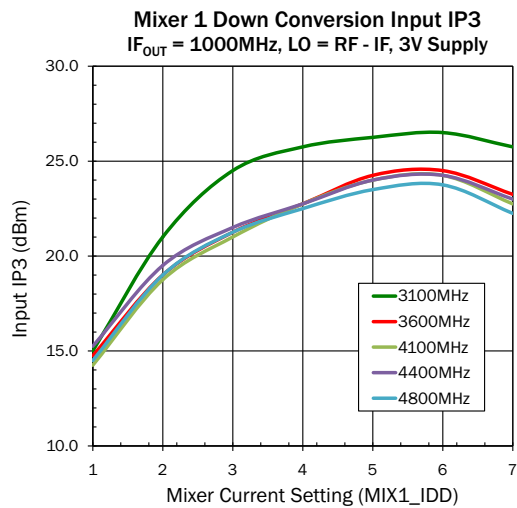
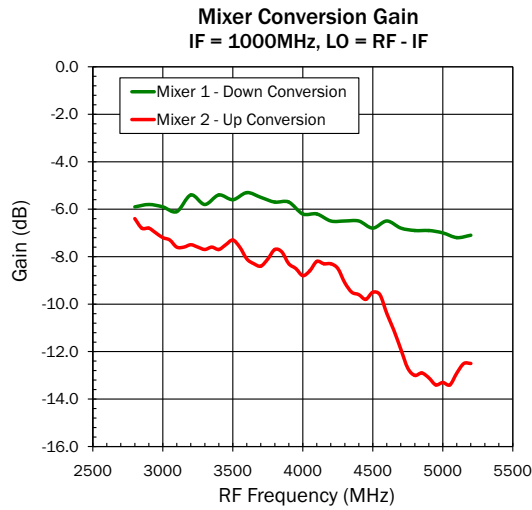
The mixer has a broadband common gate input, with real impedance of around 75Ω to 85Ω, dependant on mixer current setting. The above balun used on the down conversion input gives good wideband performance without any further matching. An output frequency of 1000MHz was selected for the down conversion tests, using the RFXF8553 4:1 transmission line transformer. A 33nH shunt inductor resonates with the mixer output capacitance to give best conversion gain at the 1000MHz IF output.

For the up conversion tests a 1000MHz input frequency was used, with the RFXF9503 1:1 transmission line transformer. For the mixer output a 4:1 balun is usually recommended to give best gain, presenting a 200Ω load to the mixer. However as frequency increases the effect of the mixer output capacitance (approximately 0.8pF) becomes more significant, rolling off gain, and is harder to match out effectively. Reducing the mixer output load using the 50Ω to 100Ω balun offers a good compromise since it reduces the effect of the output capacitance. The disadvantage of the 4000BL14U100 balun when used on the mixer output is that its phase imbalance increases rapidly above 4GHz, with the result that the common mode rejection ratio (CMRR) of the balun is reduced. This means that common mode noise and spur levels at the output will increase as the balun CMRR reduces.



Note: The results overpage are measured between SMA connectors on the FC5071410(2) evaluation board, BOM modified as shown above. The results include all balun and PCB losses.

Typical results for the RFFC5071 mixers from 3100MHz to 4800MHz



RF Frequency Range 4900MHz to 5900MHz

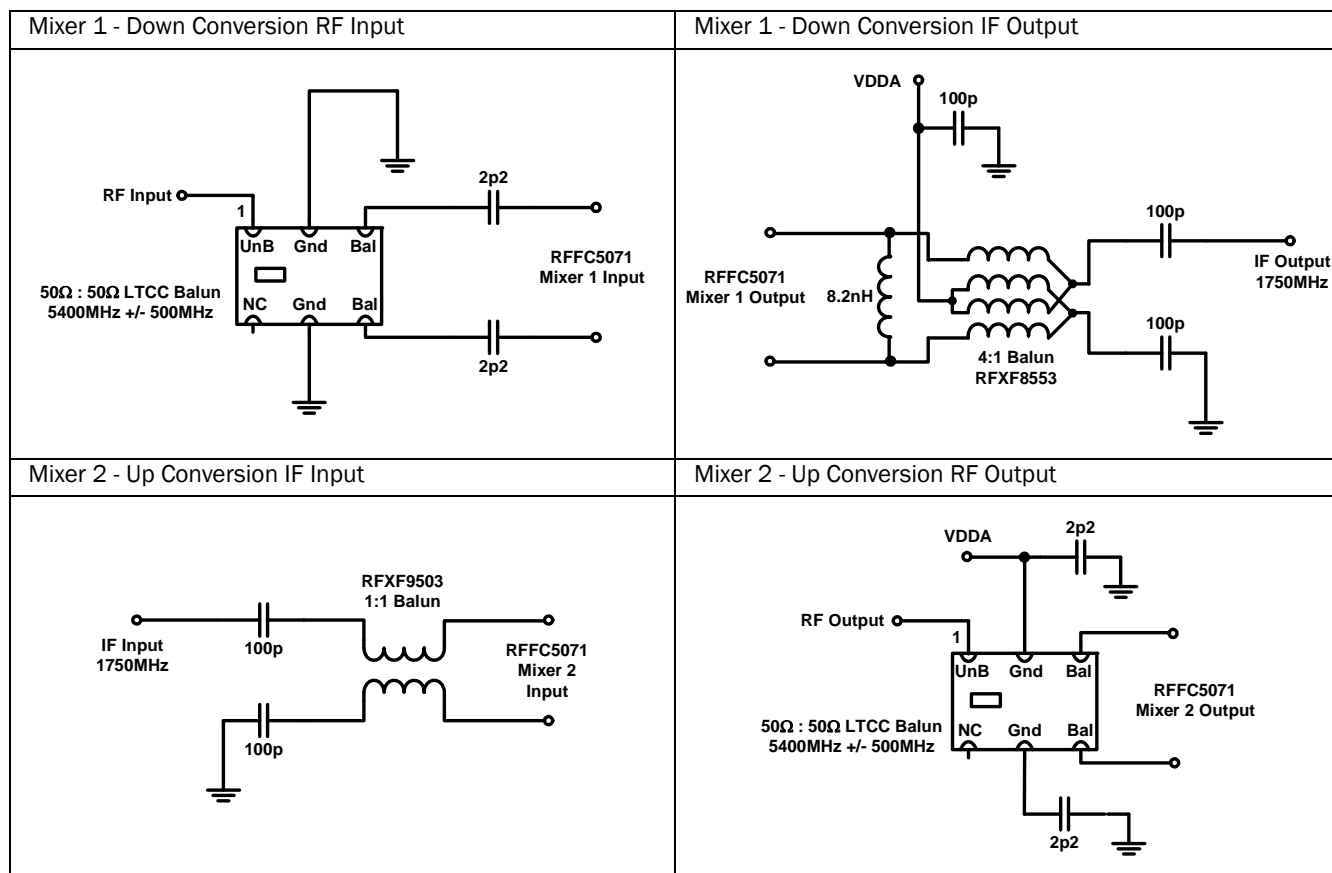
The following ceramic hybrid balun was used on the RF ports of the mixer:

Johanson Technology, 5400BL15B050, 50Ω to 50Ω, 4900MHz to 5900MHz

The mixer has a broadband common gate input, with real impedance of around 75Ω to 85Ω, dependant on mixer current setting. The above balun used on the down conversion input gives good performance from 4900MHz to above 5900MHz without any further matching. An output frequency of 1750MHz was selected for the down conversion tests, using the RFXF8553 4:1 transmission line transformer. An 8.2nH shunt inductor resonates with the mixer output capacitance to give best conversion gain at the 1750MHz IF output.

For the up conversion tests input frequencies of 1750MHz and 2000MHz were used, with the RFXF9503 1:1 transmission line transformer. For the mixer output above 5GHz reducing the mixer output load using the 50Ω to 50Ω balun above was found to give best gain since it reduces the effect of the output capacitance.

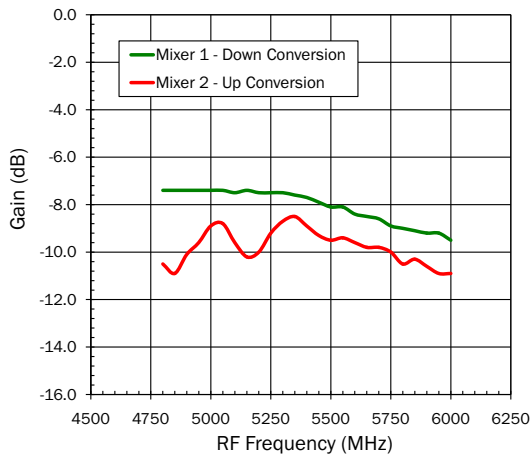
The IF of above 1700MHz was chosen since it enables the maximum RF frequency of 5900MHz to be achieved with the maximum specified LO frequency of the RFFC507x devices of 4200MHz. Note that the RFXF8553 and RFXF9503 transformers will be more lossy above 1700MHz.



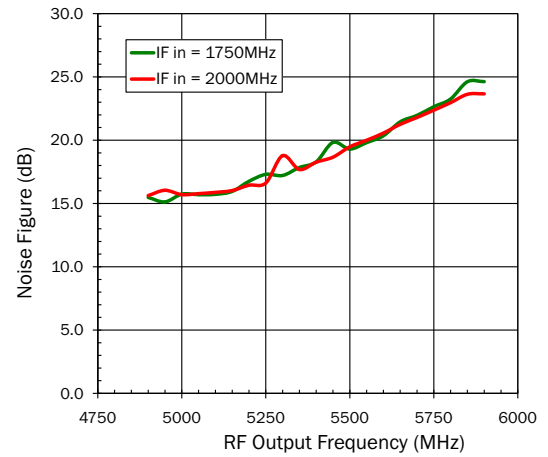
Note: The results overpage are measured between SMA connectors on the FC5071410(2) evaluation board, BOM modified as shown above. The results include all balun and PCB losses.

Typical results for the RFFC5071 mixers from 4900MHz to 5900MHz

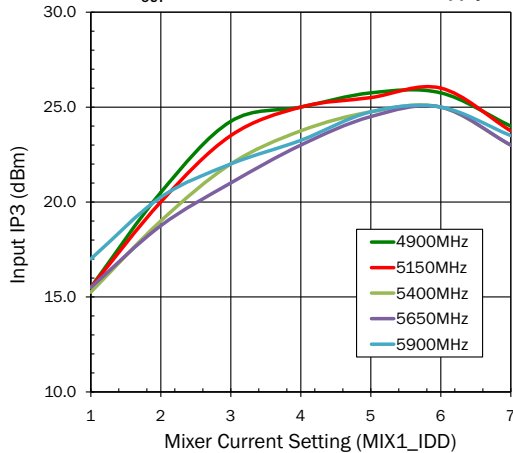
Mixer Conversion Gain
IF = 1750MHz, LO = RF - IF



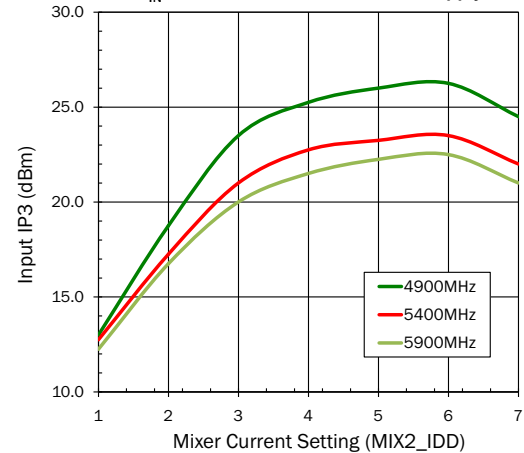
Mixer 2 Up Conversion Noise Figure
MIX2_IDD= 4, LO = RF - IF



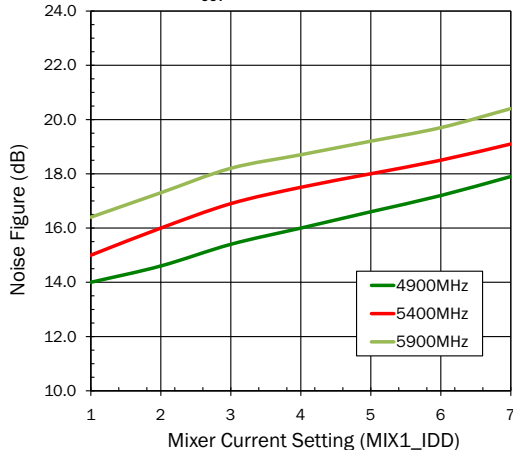
Mixer 1 Down Conversion Input IP3
IF_{OUT} = 1750MHz, LO = RF - IF, 3V Supply



Mixer 2 Up Conversion Input IP3
IF_{IN} = 2000MHz, LO = RF - IF, 3V Supply



Mixer 1 Down Conversion Noise Figure
IF_{OUT} = 1750MHz, LO = RF - IF



Mixer 2 Up Conversion Noise Figure
IF_{IN} = 2000MHz, LO = RF - IF

