Integrated Synthesizer/Mixer Programming Guide

Covers the following products:
Single mixer: RFFC2072, RFFC5072, RFFC2072A, RFFC5072A
Dual mixers: RFFC2071, RFFC5071, RFFC2071A, RFFC5071A

RFMD Multi-Market Products Group

REVISION HISTORY

Version	Date	Description of change(s)	Author(s)
2.0	25-Jun-12	Added section on programming the A series devices with VCO temperature compensation.	Eric Schonthal
1.4	01-Jun-11	Removed section 3, Device Setup This section appears in document titled : *Integrated Synthesizer/Mixer/Modulator Family Register Map Description*	Barbara Cox
1.3	18-Apr-11	Improved images in section 2. New Signals and Timing Section added	Barbara Cox
1.2	17-Mar-11	Changes to maximum frequency of operation of CT-cal circuitry.	Barbara Cox
1.1	07-Dec-10	Correction to LO Integers on Page 10	Barbara Cox
1.0	22-Oct-10	First publication	Robert Pipkin
0.3	21-Oct-10	Prep for publication	Robert Pipkin
0.2	29-Sep-10	Updated to allow for new spec on max VCO frequency during CT cal and for passing on to MarCom	Chris Shepherd
0.1	01-Jul-10	Second Draft	Chris Shepherd
0.0	29-Jun-10	Initial Draft for second revision of the chip	Chris Shepherd

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1. INTRODUCTION

RFMD's second-generation integrated synthesizer/mixer RFFCxxxx series of devices (also known as Slice2) are intended to provide features similar to the first-generation RF205x series (Slice1), but with:

- Better phase noise
- VCO auto-selection
- General purpose outputs
- Higher frequency operation (in the RFFC5xxx series)
- Device control via the serial bus

The Slice2+ devices that have an A suffix also feature advanced VCO temperature compensation. This is addressed in section 3.

Figure 1. Integrated synth/mixer block diagram (dual mixer variant)

2. STEPS FOR PROGRAMMING THE DEVICE

2.1 DETAILS FOR SETTING UP DEVICE OPERATION

2.2 DETAILS FOR SETTING CALIBRATION MODE

2.3 DETAILS FOR SETTING OPERATING FREQUENCIES

2.3.1 Calculating Divider Values

There are three dividers on the chip controlling the local oscillator frequency: the LO divider, the N-divider, and the LO's associated prescaler. The prescaler is required to restrict the input frequency to the N-divider to a maximum frequency of 1.6GHz. This is illustrated below:

Figure 2. Simplified block diagram of the frequency synthesizer

The divider values should be calculated in the following order:

1. The LO divider (lo_div)
2. The N-divider (n, nummsb, numlsb)

	n_lo	=	$INT(\log_2(f_{VCOmax} / f_{LO}))$
lodiv		=	2^{n_lo}
	f_{VCO}	=	lo_div * f_{LO}
fbkdiv		=	2 (f_{VCO} < 3.2GHz)
		=	4 (f_{VCO} > 3.2GHz)
	n_div	=	f_{VCO} / fbkdiv / f_{PD}
n		=	INT(n_div)
nummsb		=	$INT(2^{16} * (n_div - n))$
numlsb		=	$INT(2^8 * (2^{16}*(n_div - n) - nummsb))$

For example an LO of 314.159265MHz with a 26MHz reference frequency would be calculated as follows:

	n_lo	=	$INT(\log_2(5400 / 314.159265)) = INT(\log_2(17.1887338736)) = 4$
lodiv		=	$2^{n_lo} = 16$
	f_{VCO}	=	$lo_div * f_{LO} = 5026.548240MHz$
fbkdiv		=	4
	n_div	=	$f_{VCO} / 4 / f_{PD} = 5026.54824 / 4 / 26 = 48.3321946154$
n		=	INT(n_div) = 48 (0x030)
nummsb		=	$INT(2^{16} * (n_div - n)) = 21770$ (0x550A)
numlsb		=	$INT(2^8 * (2^{16}*(n_div - n) - nummsb)) = 181$ (0x85)

2.4 DETAILS FOR SETTING LOOP FILTER CALIBRATION MODE

2.5 DETAILS FOR ENABLING THE DEVICE

For optimum VCO phase noise the prescaler divider should be set to divide by 2. If the VCO frequency is greater than 3.2GHz, it is necessary to set the ratio to 4 to allow the CT_cal algorithm to work. After the device is enabled, the divider values can be reprogrammed with the prescaler divider ratio of 2 and the new n, nummsb, and numlsb values. Taking the previous example of an LO of 314.159265MHz:

fbkdiv = 2

n_div = f_{VCO} / 2 / f_{PD} = 5026.54824 / 2 / 26 = 96.66438923

n = INT(n_div) = 96 (0x060)

nummsb = INT(2^{16} * (n_div – n)) = 43541 (0xAA15)

numlsb = INT(2^{8} * (2^{16}*(n_div – n) - nummsb)) = 106 (0x6A)

These new values would be programmed into the device. Since the VCO frequency is unaffected, the CT_cal value will be correct.

3. THE A SERIES WITH VCO TEMPERATURE COMPENSATION

The devices with an A suffix (RRFC2071A, RFFC2072A, RFFC5071A and RFFC5072A) all feature advanced VCO temperature compensation circuits that deliver stable synthesizer performance across the operating temperature range of -40°C to +85°C. There is no requirement to re-calibrate the VCO with changing temperature.

The programming for the A devices is almost identical to the standard parts, so the programming in section 2 above applies. There are just two extra register settings that need to be written at set-up (see section 2.1) to get the best performance from the synthesizer:

- Set icpup = 3 in VCO_CTRL register, charge pump up enable
- Set ldlev = 1 in PLL_CTRL register, sets wide lock detect range

There are two new registers for the VCO temperature compensation, T_VCO and T_CTRL, but these do not need to be programmed. The default settings in T_VCO and T_CTRL are required for standard operation. Please refer to the Integrated Synthesizer/Mixer Register Map and Programming Guide for further details.

Note that the A devices also have some changes to the default (or reset) register settings, as follows. These do not need to be written during the device set up phase, section 2.1:

P2_FREQ1:*p2vcosel* = 0

VCO_AUTO:*ct_min* = 0

VCO_AUTO:*ct_max* = 127

CT_CAL1:*p1ctv* = 12

CT_CAL2:*p2ctv* = 12

TEST:rgbyp = 1

4. REFERENCES

1. RFMD company web site (http://www.rfmd.com)
2. RFMD Integrated Synthesizer and Mixer web site (http://rfmd.com/products/IntSynthMixer/)
3. Integrated Synthesizer/Mixer Evaluation Boards and Programming Tool (http://www.rfmd.com/CS/Documents/IntegratedSyntMixerEvalBoardandGUIUserGuide.pdf)
4. Integrated Synthesizer/Mixer Register Map and Programming Guide (http://www.rfmd.com/CS/Documents/IntegratedSynthMixerRegMapProgrammingGuide.pdf)