Phase frequency detector and charge pump

SPECIFICATION

1 FEATURES

- SMIC CMOS 0.18µm
- Charge pump current control (40 µA, 60 µA, 80 µA, 100 µA)
- Wide range of charge pump output voltage (0.3V…1.56V)
- PFD polarity selection
- Lock time selection (64, 128, 216, 512 periods of reference frequency signal)
- Without external components
- Supported foundries: TSMC, UMC, Global Foundries, SMIC, iHP, AMS, Vanguard, SilTerra

2 APPLICATION

- PLL
- Frequency synthesizer
- Functional signal generator
- Communication devices

3 OVERVIEW

The device consists of phase frequency detector (PFD), charge pump and lock detector (LD) PFD compares phases of a divided VCO signal and a divided reference oscillator signal. PFD feeds control signal to charge pump at signals mismatch. Charge pump output current forms VCO control voltage.
Lock detector forms output logical “1” at input signals phase coincidence.
The block is fabricated on SMIC CMOS 0.18µm technology.

4 STRUCTURE

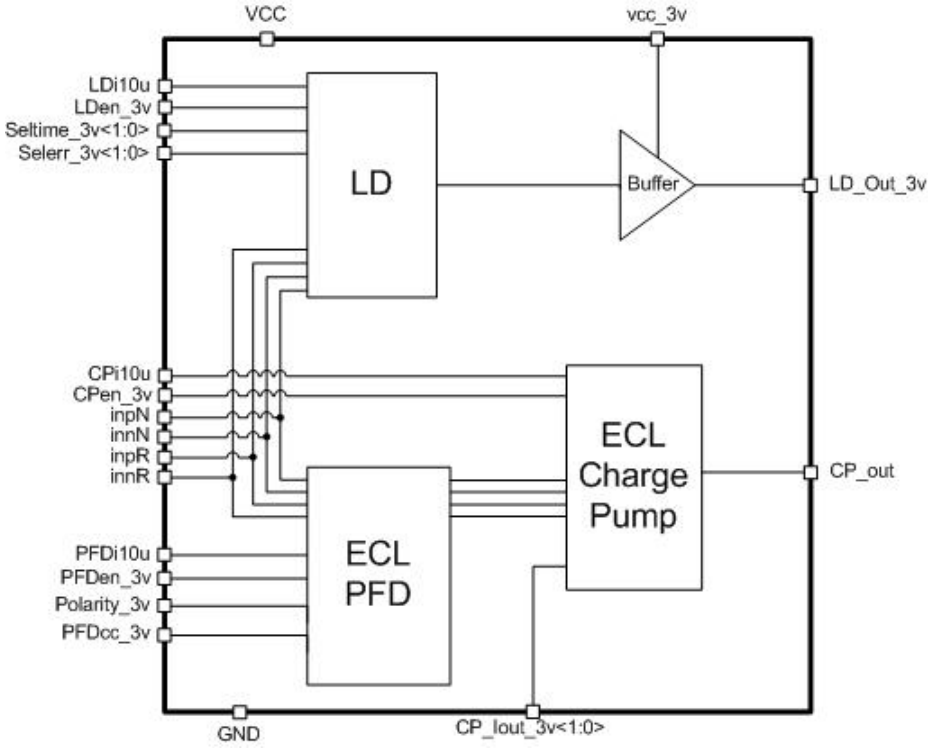

Figure 1: PFD structure.

5 PIN DESCRIPTION

Name	Direction	Description
InpN	I	VCO divided differential signal input
InnN	I	
inpR	I	Differential signal input from reference oscillator
innR	I	
PFDi10u	I	PFD reference current (10µA)
CPi10u	I	Charge pump reference current (10µA)
LDi10u	I	Lock detector reference current (10µA)
PFDen_3v	I	PFD enable/disable
CPen_3v	I	Charge pump enable/disable
LDen_3v	I	Lock detector enable/disable
Polarity_3v	I	PFD polarity
CP_Iout<1:0>	I	Charge pump output current control
SelErr_3v	I	Detection accuracy adjustment
SelTime_3v<1:0>	I	Detection period adjustment
PFDcc_3v	I	PFD current control
CP_out	O	Charge pump output
LD_out	O	Lock detector output
Vcc_3v	IO	LD buffer supply voltage
PFD_VCC	IO	Supply voltage
PFD_GND	IO	Ground

6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

Table 1: Block dimensions.

Dimension	Value	Unit
Height	162.36	µm
Width	253.77	µm

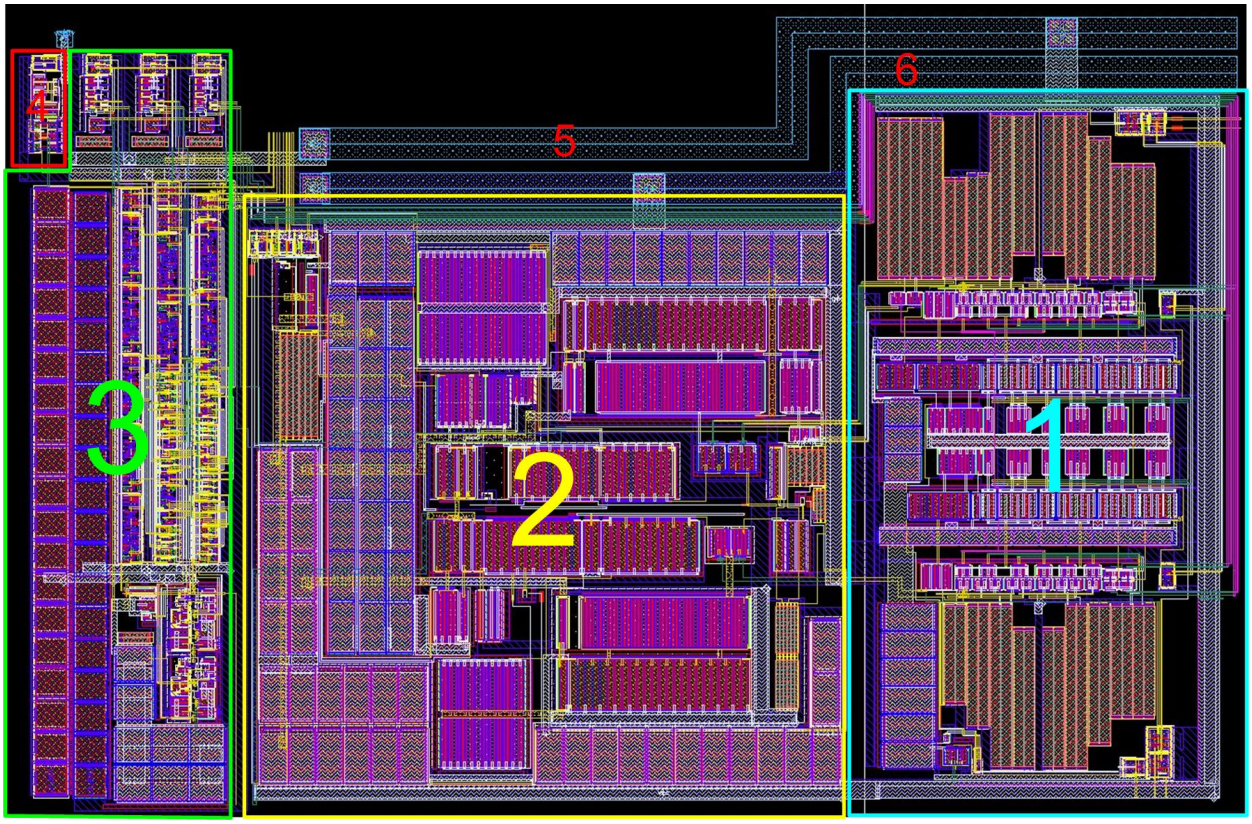

Figure 2: Device layout view.

1. ECL PFD
2. Charge pump
3. Lock detector
4. Lock detector buffer
5. Supply voltage bus
6. Ground bus

7 OPERATING CHARACTERISTICS

7.1 TECHNICAL CHARACTERISTICS

Technology _____ SMIC CMOS 0.18 µm
Status _____ silicon proven
Area _____ 0.04 mm^2

7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for V_{cc} = 1.7 ÷ 1.9 V and T = -45 ÷ +85°C. Typical values are at V_{cc} = 1.8 V and T = +27° C, unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ	max	
Supply voltage	V_{CC}	-	1.7	1.8	1.9	V
Operating temperature range	T	-	-45	27	85	ºC
Reference frequency	F	-	-	24.84	-	MHz
Output voltage	V_{out}	-	0.3	0.66	1.56	V
Output current	I_{out}	Preset 1	40	41	42	µA
		Preset 2	60	61	62	
		Preset 3	80	81	83	
		Preset 4	100	101	103	
PFD reset time	t_{rst}	-	1.5	2.5	3.5	ns
Lock monitoring time	MP	-	2.58	-	20.6	µs
Lock detector accuracy	Serr	Preset 5	6.5	7	7.5	ns
		Preset 6	13	14	15	
Current consumption in an active mode	I_{cc}	-	1.29	1.35	1.4	mA
Current consumption in a standby mode	I_{stb}	-	-	6.6	820	nA
Input logic-high level	V_{IH}	For digital inputs	0.7 V_{cc}	-	3.6	V
Input logic-low level	V_{IL}		-0.25	-	0.3	V

Table 2: Preset description.

Preset	Control signal	Description
Preset 1	CP_Iout=”00”	Charge pump output current adjustment
Preset 2	CP_Iout=”01”	
Preset 3	CP_Iout=”10”	
Preset 4	CP_Iout=”11”	
Preset 5	LD_SelErr=”0”	Lock detector accuracy adjustment
Preset 6	LD_SelErr=”1”	

8 DELIVERABLES

IP contents:

- Schematic or NetList
- Layout or blackbox
- Extracted view (optional)
- GDSII
- DRC, LVS, antenna report
- Test bench with saved configurations (optional)
- Documentation