

Quadrature former

SPECIFICATION

1 FEATURES

- TSMC CMOS 65 nm
- Output frequency range 0.075-3 GHz
- Input frequency division (by 2, 4, 8, 16, 32 or 64)
- High accuracy of the phase control
- Output signal strobbing
- Portable to other technologies (upon request)

2 APPLICATION

- Quadrature signal processing for mixer

3 OVERVIEW

This device is designed to generate a quadrature local oscillator signal. A quadrature generator circuit constructed in CMOS logic and consists of two converters ECL/CMOS, quadrature former with input frequency divider by 2 or 4, prescaler by 2, 4, 8, 16 and phase control block, with ability of fine tuning of output signal phase. To reduce phase noise output triggers are strobbed by high-frequency signal.

4 STRUCTURE

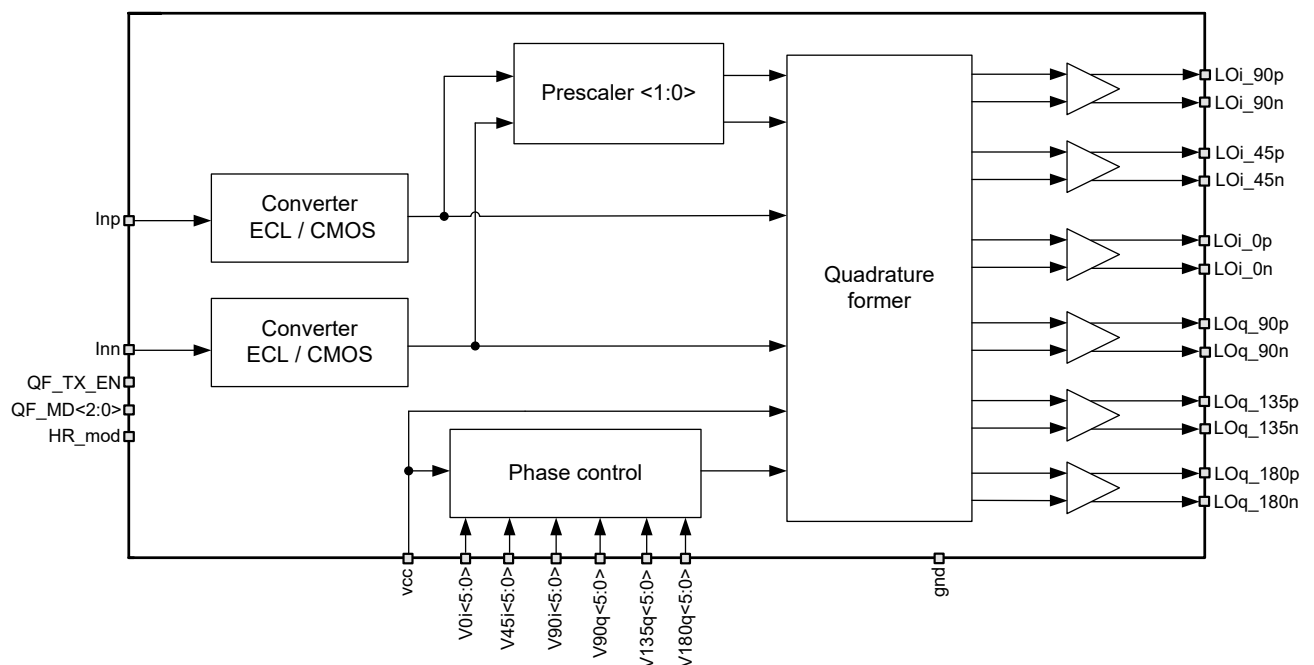


Figure 1: Quadrature former structure

5 PIN DESCRIPTION

| Name | Direction | Description |
|------------|-----------|---|
| QF_TX_EN | I | Enable/disable QF |
| QF_MD<2:0> | I | Division ratio selection |
| HR_mod | I | Quadrature former harmonic rejection mode selection |
| V0i<5:0> | I | Phase correction control for I- channel |
| V45i<5:0> | I | Phase correction control for I0 channel |
| V90i<5:0> | I | Phase correction control for I+ channel |
| V90q<5:0> | I | Phase correction control for Q- channel |
| V135q<5:0> | I | Phase correction control for Q0 channel |
| V180q<5:0> | I | Phase correction control for Q+ channel |
| Inp | I | Differential input from VCO |
| Inn | I | |
| LOi_90p | O | I+ channel differential output |
| LOi_90n | O | |
| LOi_45p | O | I0 channel differential output |
| LOi_45n | O | |
| LOi_0p | O | I- channel differential output |
| LOi_0n | O | |
| LOq_90p | O | Q- channel differential output |
| LOq_90n | O | |
| LOq_135p | O | Q0 channel differential output |
| LOq_135n | O | |
| LOq_180p | O | Q+ channel differential output |
| LOq_180n | O | |
| vcc | IO | Supply voltage 1.2 V |
| gnd | IO | Ground |

6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

Table 1: Block dimensions.

| Dimension | Value | Unit |
|-----------|-------|---------------|
| Height | 450 | μm |
| Width | 165 | μm |

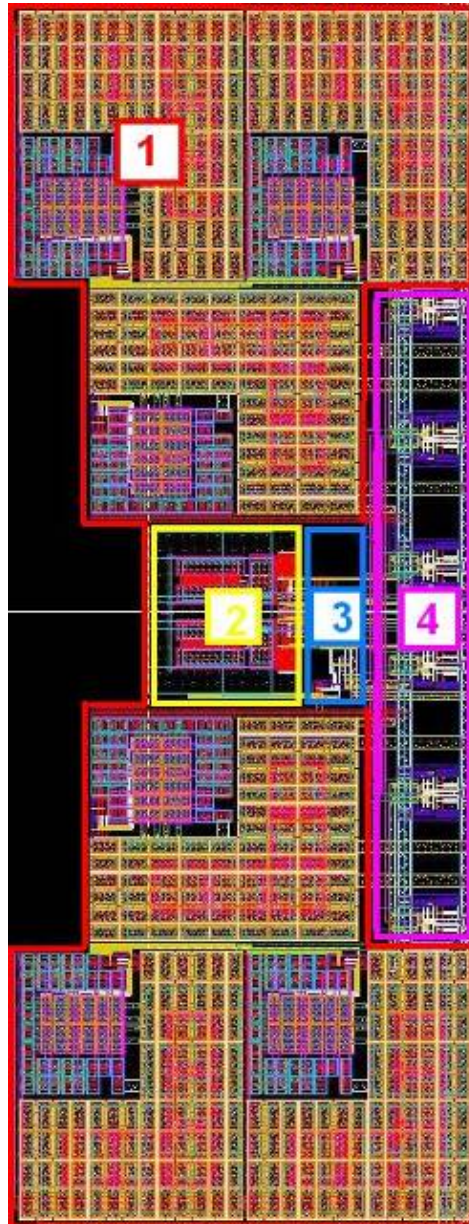


Figure 2: Quadrature former layout view

1. Phase control
2. Converters ECL/CMOS
3. Prescaler and Quadrature former
4. Strobing triggers and amplifying buffers

7 OPERATING CHARACTERISTICS

7.1 TECHNICAL CHARACTERISTICS

Technology _____ TSMC 65 nm CRN65LP

Status _____ silicon proven

 Area _____ 0.068 mm²

7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for $V_{cc} = 1.14 \div 1.26$ V and $T = -40 \div 125$ °C. Typical values are at $V_{cc} = 1.2$ V and $T = 85$ °C, unless otherwise specified.

| Parameter | Symbol | Condition | Value | | | Unit |
|------------------------|-------------------|----------------|--------------|----------|--------------|--------|
| | | | min | typ | max | |
| Supply voltage | V_{cc} | - | 1.14 | 1.2 | 1.26 | V |
| Temperature range | T | - | -40 | +85 | +125 | °C |
| Input frequency range | F_{in} | - | 3.0 | - | 6.0 | GHz |
| Output frequency range | F_{out} | - | 0.075 | - | 3 | GHz |
| Division ratio | N | Division by 2 | - | 2 | - | - |
| | | Division by 4 | - | 4 | - | |
| | | Division by 8 | - | 8 | - | |
| | | Division by 16 | - | 16 | - | |
| | | Division by 32 | - | 32 | - | |
| | | Division by 64 | - | 64 | - | |
| Output amplitude | $V_{out_{p-p}}$ | CMOS | - | V_{cc} | - | V |
| Input amplitude | $V_{in_{p-p}}$ | - | 0.5 | - | - | V |
| IQ phase error | φ | - | - | - | ±4 | degree |
| Phase adjustment range | $\varphi_{corr.}$ | - | ±0.05 | - | ±5 | degree |
| Current consumption | I_{av} | - | - | 11 | 15 | mA |
| Input logic-level high | V_{IH} | - | $0.85V_{cc}$ | - | $1.15V_{cc}$ | V |
| Input logic-level low | V_{IL} | - | -0.1 | - | +0.1 | V |

8 TYPICAL CHARACTERISTICS

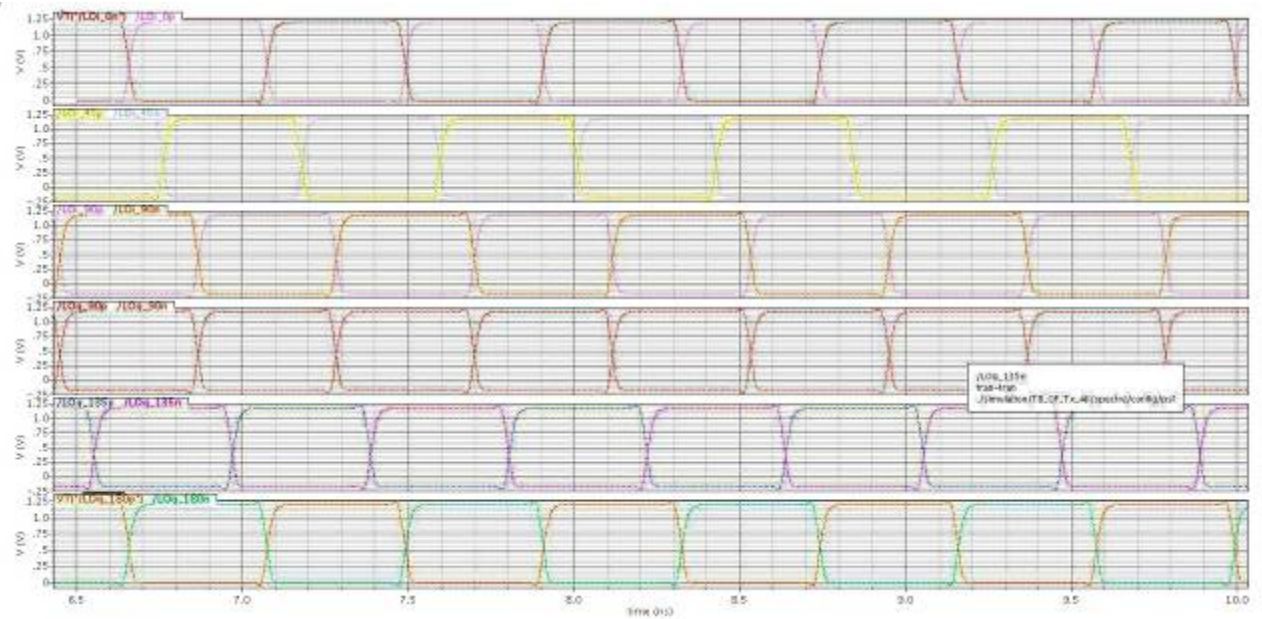


Figure 3: The time diagram of the quadrature former

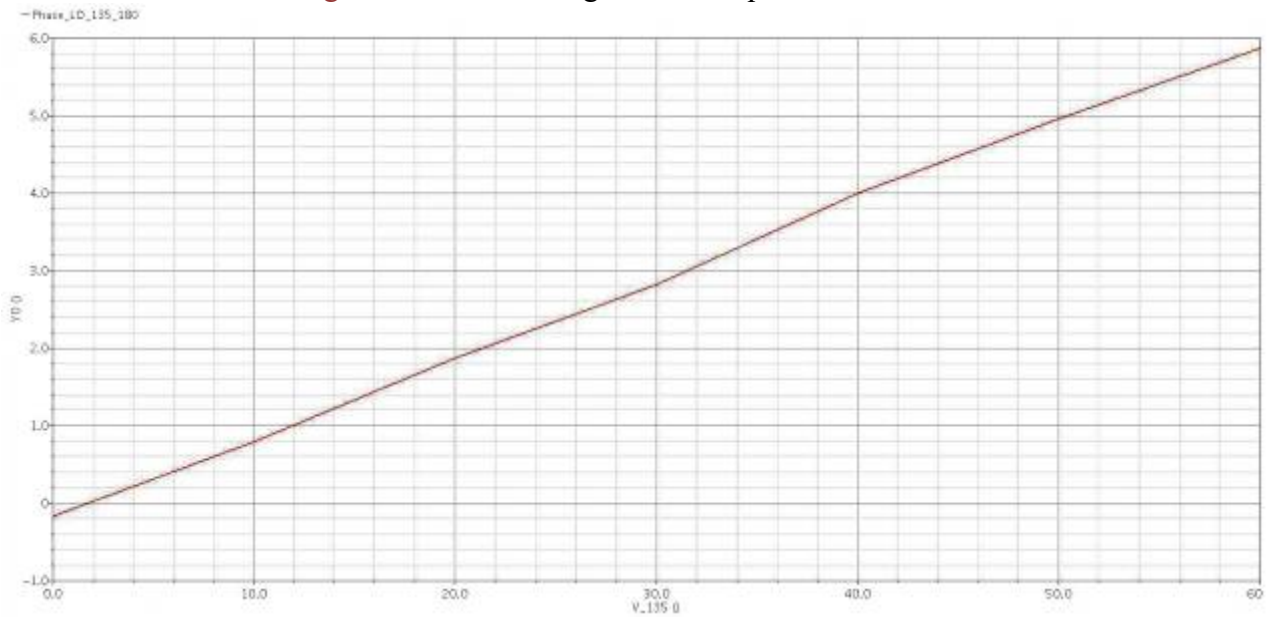


Figure 4: Phase tuning range (heterodyne = 1.5 GHz)

9 DELIVERABLES

IP contents:

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