

**X-band RX-TX Core Chip**  
GaAs Monolithic Microwave IC

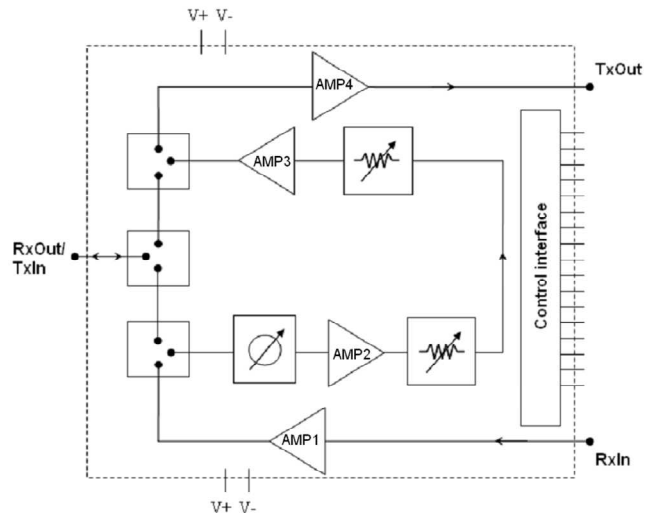
*Preliminary*

**Description**

The CHC3014 is a Receive and Transmit X band Core Chip.

It includes a 6 bit phase shifter, a 6 bit attenuator, a second 2 bit attenuator for tuning, self-biased buffers, switch and TTL compatible parallel interfaces.

This device is manufactured 0.25  $\mu$ m pHEMT process, including via holes through the substrate.



**Main Features**

- Operating frequency range: 8 -12 GHz
- Receive path linear gain: 13.5 dB
- Transmit path linear gain: 25 dB
- Phase shift range: 0-360° (step 5.625°)
- Fine attenuator: 34.65dB (step 0.55dB)
- Tuning attenuator: 6dB (step 2dB)
- Chip size: 4.47 x 5.07 x 0.1mm

**Main Characteristics**

V+ = 5V / V- = -5V

| Symbol             | Parameter                                   | Min | Typ  | Max | Unit |
|--------------------|---|-----|------|-----|------|
| Freq               | Frequency range                             | 8   |      | 12  | GHz  |
| Rms_pe             | RMS phase error                             |     | 2    |     | °    |
| Rms_att            | RMS attenuation error                       |     | 0.3  |     | dB   |
| P1dB <sub>RX</sub> | Output power at RXOUT @1dB gain compression |     | 16.5 |     | dBm  |
| P <sub>satTX</sub> | Output power at TXOUT at saturation         |     | 20   |     | dBm  |
| NF                 | Noise figure in RX mode                     |     | 5.8  |     | dB   |

ESD Protection: Electrostatic discharge sensitive device. Observe handling precautions!

## Electrical Characteristics

T= +25°C

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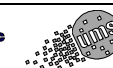
| Symbol                  | Parameters  | Min | Typ                     | Max | Unit |
|-------------------------|---|-----|-------------------------|-----|------|
| Freq                    | Operating frequency   | 8   |                         | 12  | GHz  |
|                         | <b>Mode RX</b>  |     |                         |     |      |
| G <sub>lRX</sub>        | Linear gain in Rx mode at reference state (1)   |     | 13.5                    |     | dB   |
| S <sub>11RX</sub>       | Input Return Loss in Rx mode  |     | -14                     |     | dB   |
| S <sub>22RX</sub>       | Output Return Loss in Rx mode   |     | -18                     |     | dB   |
| NF                      | Noise figure in Rx mode (2)   |     | 5.8                     |     | dB   |
| P <sub>1dBcRX</sub>     | Output power at RXOUT at 1dB gain compression   |     | 16.5                    |     | dBm  |
|                         | <b>Mode TX</b>  |     |                         |     |      |
| G <sub>lTX</sub>        | Linear gain in Tx mode at reference state (1)   |     | 25                      |     | dB   |
| S <sub>11TX</sub>       | Input Return Loss in Tx mode  |     | -14                     |     | dB   |
| S <sub>22TX</sub>       | Output Return Loss in Tx mode   |     | -12                     |     | dB   |
| P <sub>INTX</sub>       | Input power range in Tx saturated mode  | 0   |                         | 15  | dBm  |
| P <sub>satTX</sub>      | Output power at TXOUT in saturated mode   |     | 20                      |     | dBm  |
|                         | <b>Isolated Mode (3)</b>  |     |                         |     |      |
| S <sub>11ISOLATED</sub> | Return Loss at RXin/TXout   |     | -15                     |     | dB   |
|                         | <b>6 bit Phase shifter (4)</b>  |     | <b>0-360</b>            |     | °    |
|                         | Phase shift elementary step   |     | 5.625                   |     | °    |
| PPE                     | Peak phase error<br>(Rx, Tx, fine attenuator state < 33 tuning attenuator state 1)<br>8 GHz-8.5GHz<br>8.5 GHz-11.5 GHz<br>11.5 GHz-12 GHz |     | 4 ± 6<br>0 ± 6<br>4 ± 6 |     | °    |
| Rms_pe                  | RMS phase error<br>(Rx, Tx, fine attenuator state < 33 tuning attenuator state 1)<br>8 GHz-8.5 GHz<br>8.5 GHz-11.5 GHz<br>11.5 GHz-12 GHz |     | 2.5<br>2<br>2.5         |     | °    |
| Ampvar                  | Amplitude variation<br>(Rx, Tx, fine attenuator state < 33 tuning attenuator state 1)   |     | 0 ± 1                   |     | dB   |
| Rms_Ampvar              | RMS Amplitude variation<br>(Rx, Tx, fine attenuator state < 33 tuning attenuator state 1)   |     | 0.3                     |     | dB   |

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| Symbol                    | Parameters  | Min  | Typ                                   | Max  | Unit |
|---------------------------|---|------|---------------------------------------|------|------|
|                           | <b>6 bit Fine Attenuator (4)</b>  |      | <b>34.65</b>                          |      | dB   |
|                           | Fine Attenuator elementary step   |      | 0.55                                  |      | dB   |
| Att_err <sub>att</sub>    | Attenuation error<br>(Rx, all phase shifter states<br>tuning attenuator state 1)<br><i>Attenuation state 0-32</i><br><i>Attenuation state 33-47</i><br><i>Attenuation state 48-63</i> |      | 0 ± 0.5<br>-0.25 ± 0.75<br>-0.5 ± 1.5 |      | dB   |
| Rms_att                   | RMS attenuation error<br>(Rx, all phase shifter states<br>tuning attenuator state 1)  |      | 0.3                                   |      | dB   |
| Phivar <sub>att</sub>     | Phase variation<br>(Rx, all phase shifter states<br>tuning attenuator state 1)<br><i>Attenuation state 0-32</i><br><i>Attenuation state 33-47</i><br><i>Attenuation state 48-63</i>   |      | 0 ± 3<br>-1 ± 5<br>-4 ± 6             |      | °    |
| Rms_Phivar                | RMS Phase variation<br>(Rx, all phase shifter states<br>tuning attenuator state 1)  |      | 2                                     |      | °    |
|                           | <b>2 bit Tuning Attenuator (5)</b>  |      | <b>6</b>                              |      | dB   |
|                           | Tuning Attenuator elementary step   |      | 2                                     |      | dB   |
| Att_Err <sub>TB</sub>     | Tuning attenuation error  |      | ± 0.3                                 |      | dB   |
| Phivar <sub>TB</sub>      | Phase variation of tuning attenuator  |      | ± 2                                   |      | °    |
|                           | <b>Biasing (6)</b>  |      |                                       |      |      |
| V+                        | Positive supply voltage   |      | 5                                     |      | V    |
| V-                        | Negative supply voltage   |      | -5                                    |      | V    |
|                           | Control voltage low level   | 0    | 0                                     | +0.4 | V    |
|                           | Control voltage high level  | +2.4 | +3.3                                  | +5   | V    |
| I <sub>+5_Rx</sub>        | Biasing current in RX mode  |      | 335                                   |      | mA   |
| I <sub>+5_Tx</sub>        | Biasing current in TX mode  |      | 350 (7)<br>470 (8)                    |      | mA   |
| I <sub>+5_interface</sub> | Control interface DC current  |      | 25                                    |      | mA   |
| I <sub>-5</sub>           | Negative DC current   |      | -50                                   |      | mA   |

- (1) Reference state: Tuning attenuator state = 1 / Fine attenuator state = 0 / Phase shifter state = 0
- (2) Noise Figure value for Tuning attenuator state = 0 / Fine attenuator state = 0 / Phase shifter state = 0
- (3) In this mode, the MFC presents a matched load on the RF access pad RXin/TXout
- (4) Low influence of cross-talking between phase shifter and fine attenuator
- (5) This function allows to adjust roughly the linear gain
- (6) Each Amplifiers of Rx and Tx paths can be switched off thanks to separate biasing pads (c.f. pad allocation table)
- (7) Tx linear mode
- (8) Tx saturated mode



*Preliminary*

## Absolute Maximum Ratings (1)

T= +25°C

| Symbol | Parameter                                     | Values      | Unit |
|--------|---|-------------|------|
| V+     | Maximum positive bias voltage                 | 6           | V    |
| V-     | Negative voltage range                        | -6 to -4    | V    |
| P_RFRX | Maximum peak input power overdrive in Rx mode | 16          | dBm  |
| P_RFTX | Maximum peak input power overdrive in Tx mode | 16          | dBm  |
| Tch    | Maximum channel temperature (2)               | 175         | °C   |
| Ta     | Operating temperature range                   | -40 to +85  | °C   |
| Tstg   | Storage temperature range                     | -55 to +125 | °C   |

- (1) Operation of this device above anyone of these paramaters may cause permanent damage.  
 (2) Thermal Resistance channel to ground paddle = 164°C/W for T= +85°C

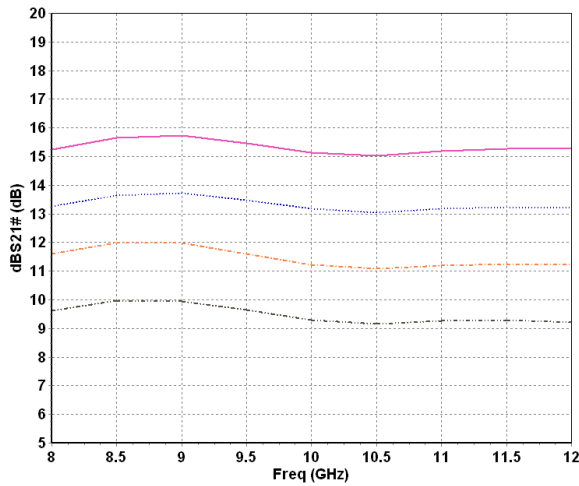
**Typical Measurements**

T= +25°C

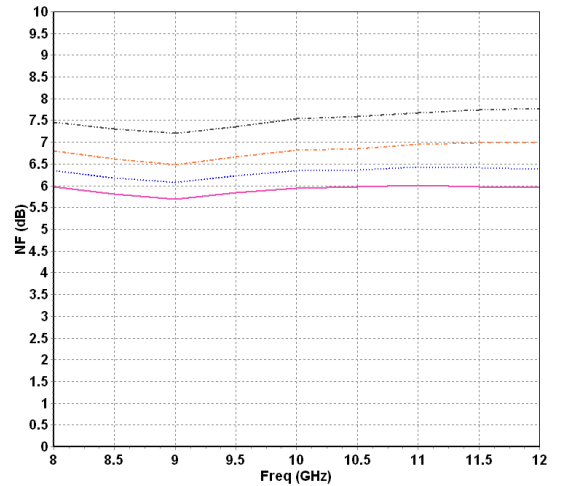
[S] parameters in RX mode

*Preliminary*

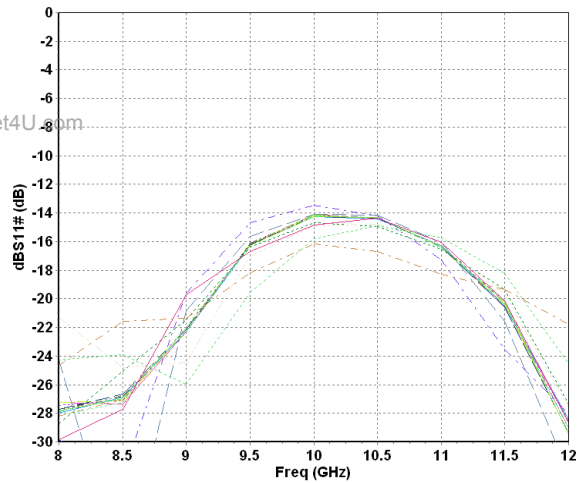
S21 vs. Frequency  
 Tuning attenuator states 0-1-2-3  
 Fine attenuator state 0, Phase shifter state 0



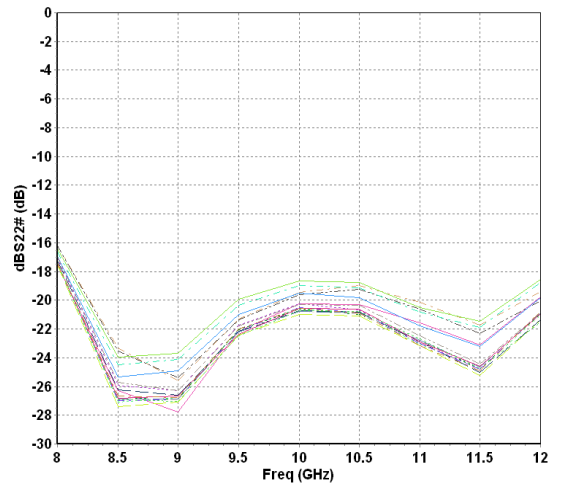
Noise Factor vs. Frequency  
 Tuning attenuator states 0-1-2-3  
 Fine attenuator state 0, Phase shifter state 0



S11 vs. Frequency  
 Tuning attenuator states 0-1-2-3  
 Fine attenuator states 0-1-2-4-8-16-32-63  
 Phase shifter states 0-1-2-4-8-16-32-63



S22 vs. Frequency  
 Tuning attenuator states 0-1-2-3  
 Fine attenuator states 0-1-2-4-8-16-32-63  
 Phase shifter states 0-1-2-4-8-16-32-63

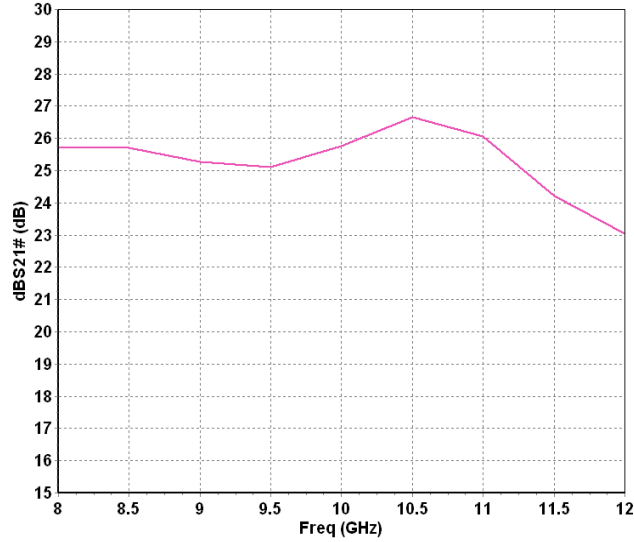


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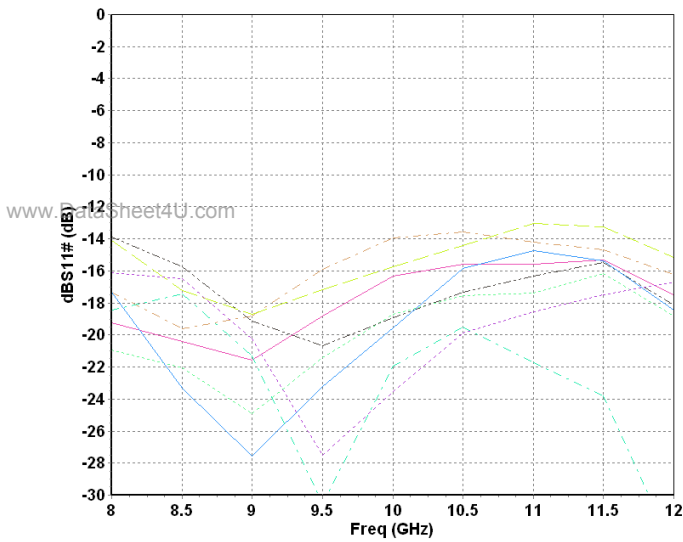
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### [S] parameters in TX mode

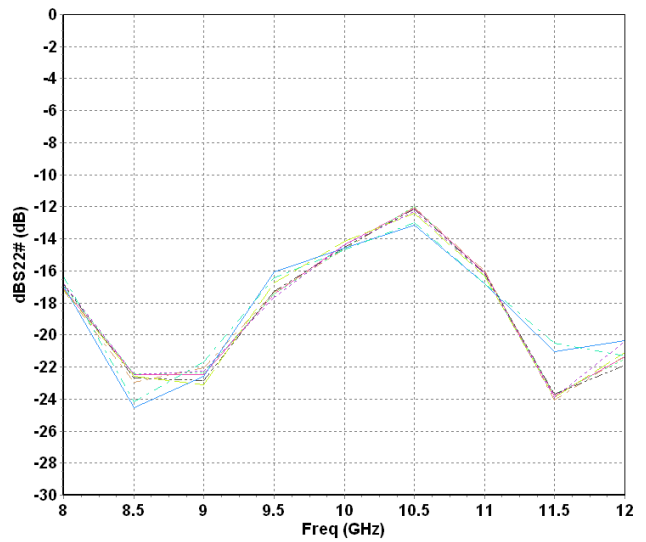
S21 vs. Frequency  
 Tuning attenuator state 1  
 Fine attenuator state 0, Phase shifter state 0



S11 vs. Frequency  
 Tuning attenuator state 1, Fine attenuator state 0  
 Phase shifter states 0-1-2-4-8-16-32-63



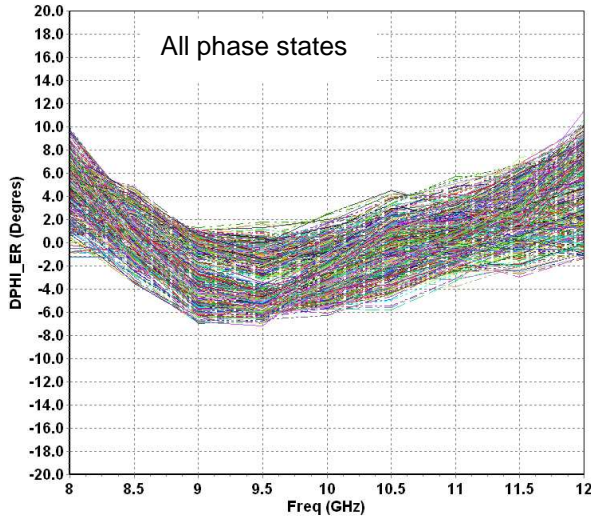
S22 vs. Frequency  
 Tuning attenuator state 1, Fine attenuator state 0  
 Phase shifter states 0-1-2-4-8-16-32-63



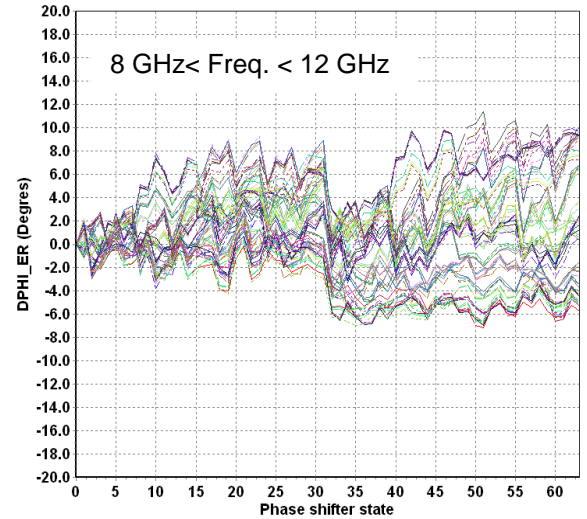
*Preliminary*

**Phase shifter performances: Phase error**

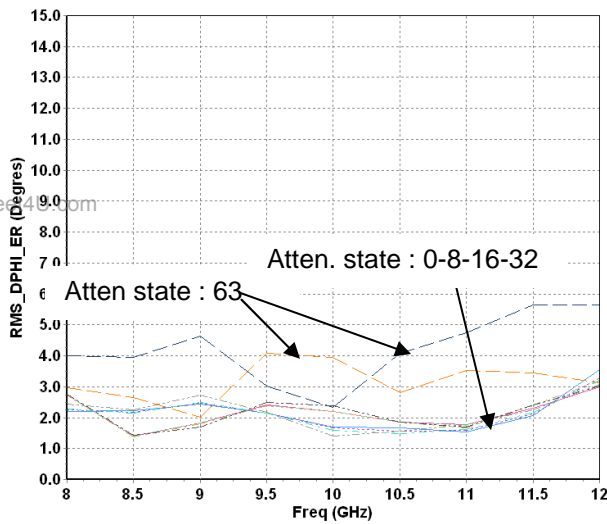
Phase error vs. frequency in RX and TX mode  
 Tuning attenuator state 1  
 Fine attenuator states 0-8-16-32



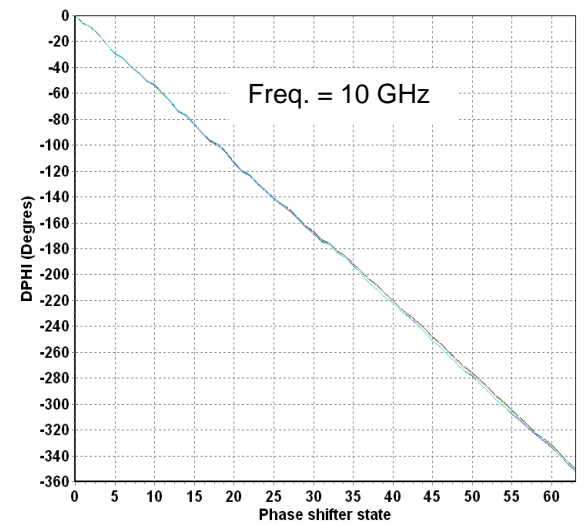
Phase error vs. phase state in RX and TX mode  
 for attenuation states 0, 8, 16, 32



RMS of phase error in RX and TX mode



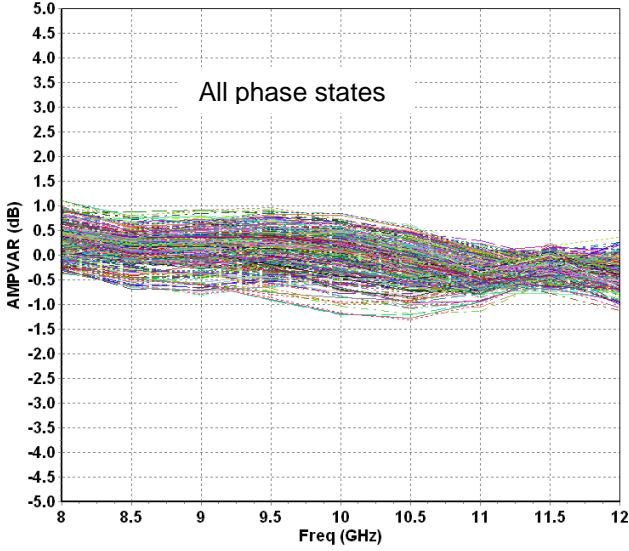
Phase shift vs. phase shifter state in RX and TX mode  
 Tuning attenuator state 1  
 Fine attenuator states 0-8-16-32



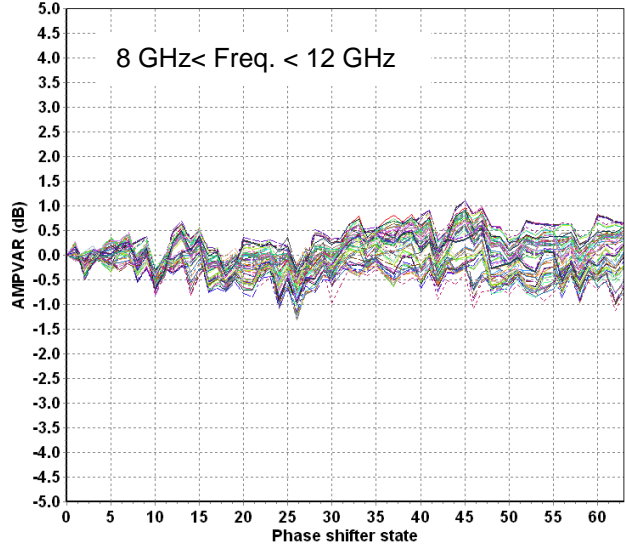
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### Phase shifter performances: Amplitude variation

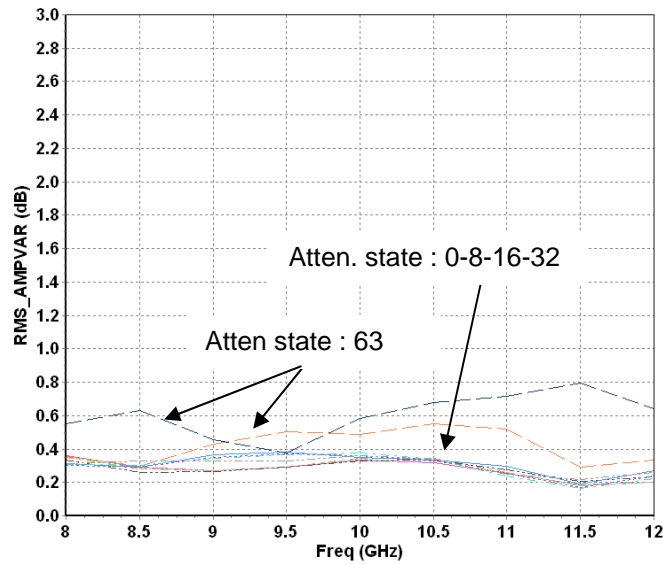
Amplitude variation vs. frequency in RX and TX mode  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32



Amplitude variation vs. phase state in RX and TX mode  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32



RMS amplitude variation in RX and TX mode  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32

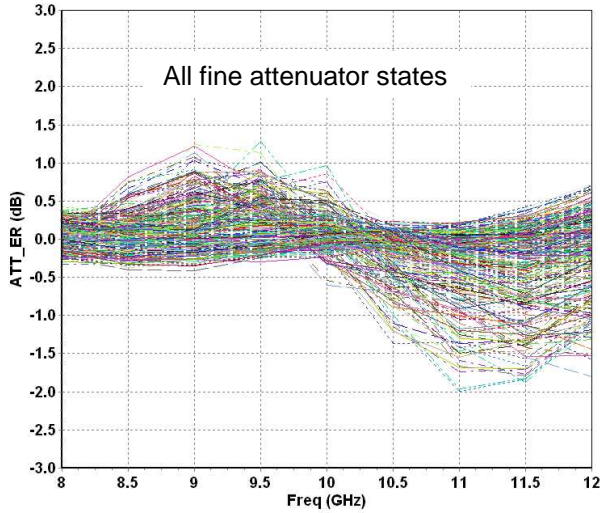


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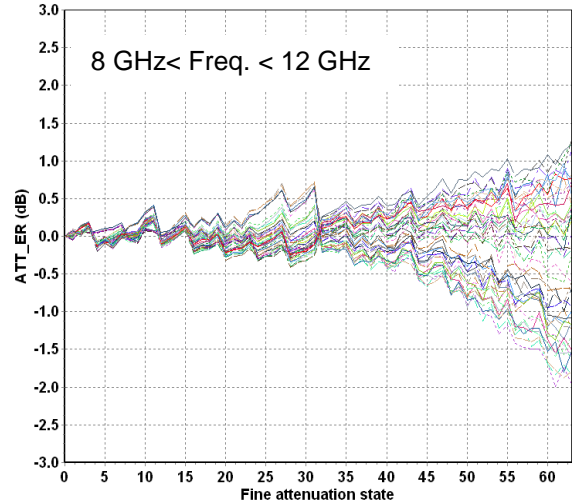


Fine Attenuator performances: Error of attenuation *Preliminary*

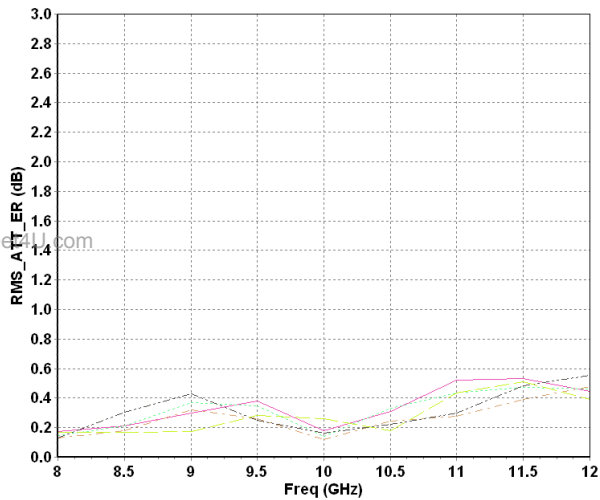
Attenuation error vs. freq. in RX mode  
 Tuning attenuator state 1  
 Phase shifter states 0-8-16-32-63



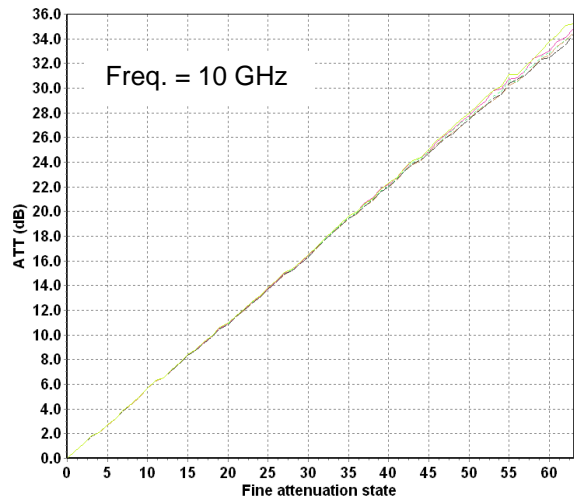
Attenuation error vs. atten. state in RX mode  
 Tuning attenuator state 1  
 Phase shifter states 0-8-16-32-63



RMS attenuation error in RX mode  
 Tuning attenuator state 1  
 Phase shifter states 0-8-16-32-63



Attenuation vs. Fine attenuator state in RX mode  
 Tuning attenuator state 1  
 Phase shifter states 0-8-16-32-63

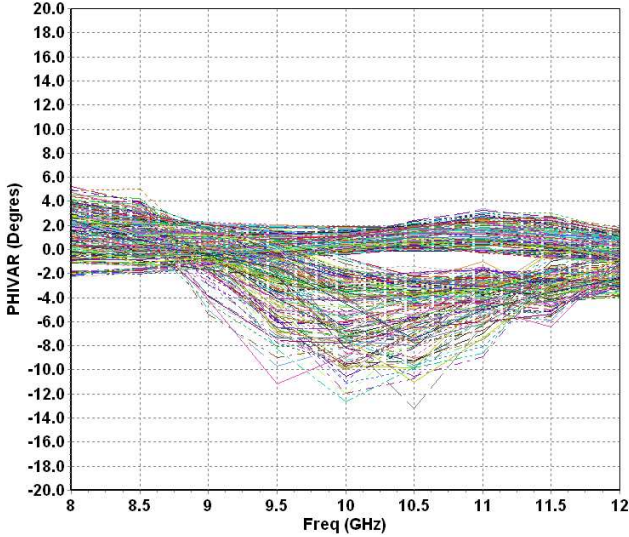


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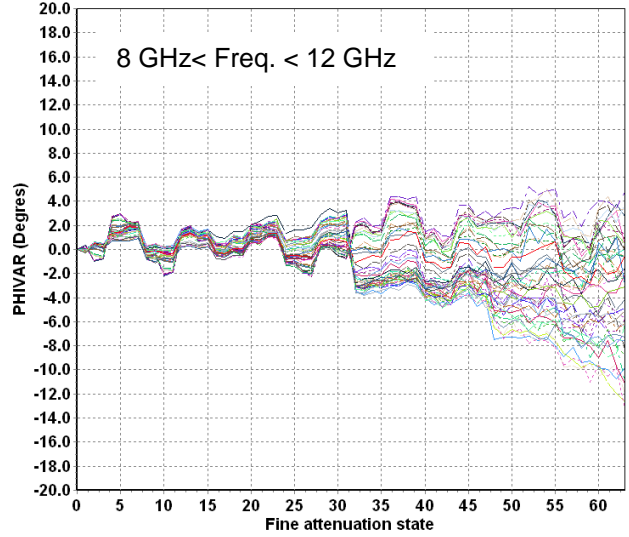
*Preliminary*

Fine Attenuator performances: phase variation

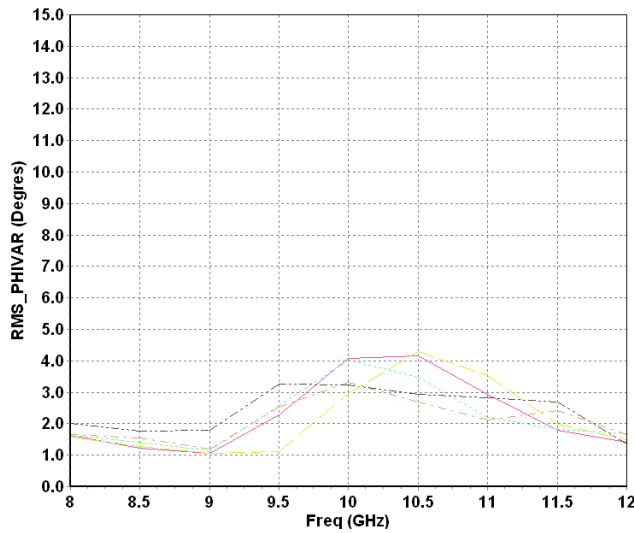
Phase variation vs. freq. in RX mode  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63



Phase variation vs. atten. state in RX mode  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63



RMS phase variation in RX mode  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63

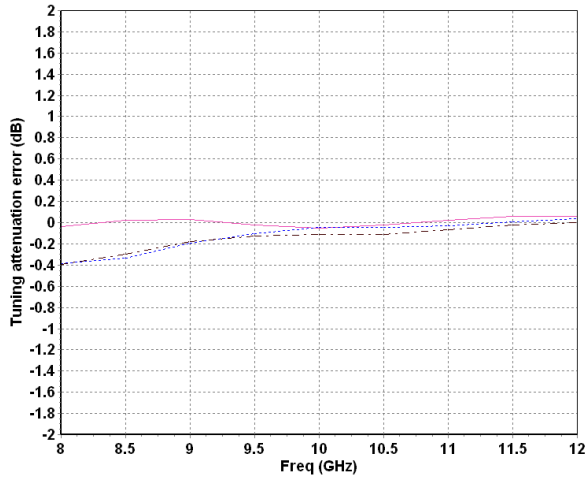


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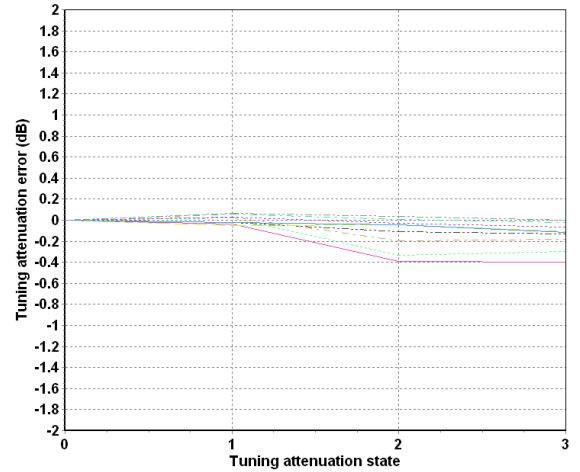
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**Tuning Attenuator performances**

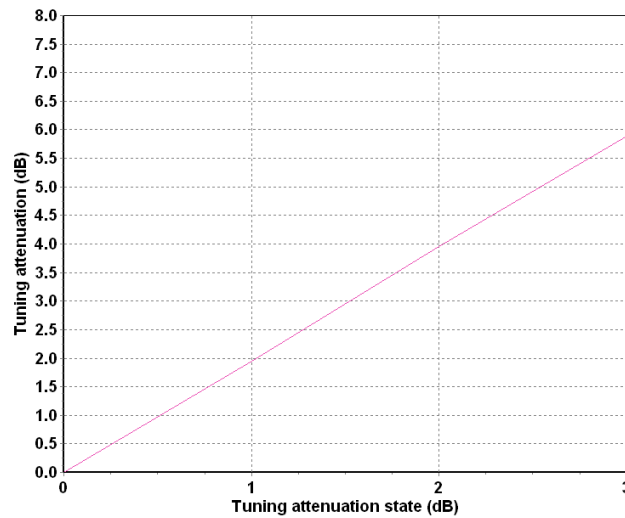
Tuning attenuation error vs. freq.  
 RX mode  
 Fine attenuator state 0, Phase shifter state 0



Phase variation of tuning attenuator vs. freq.  
 RX mode  
 Fine attenuator state 0, Phase shifter state 0



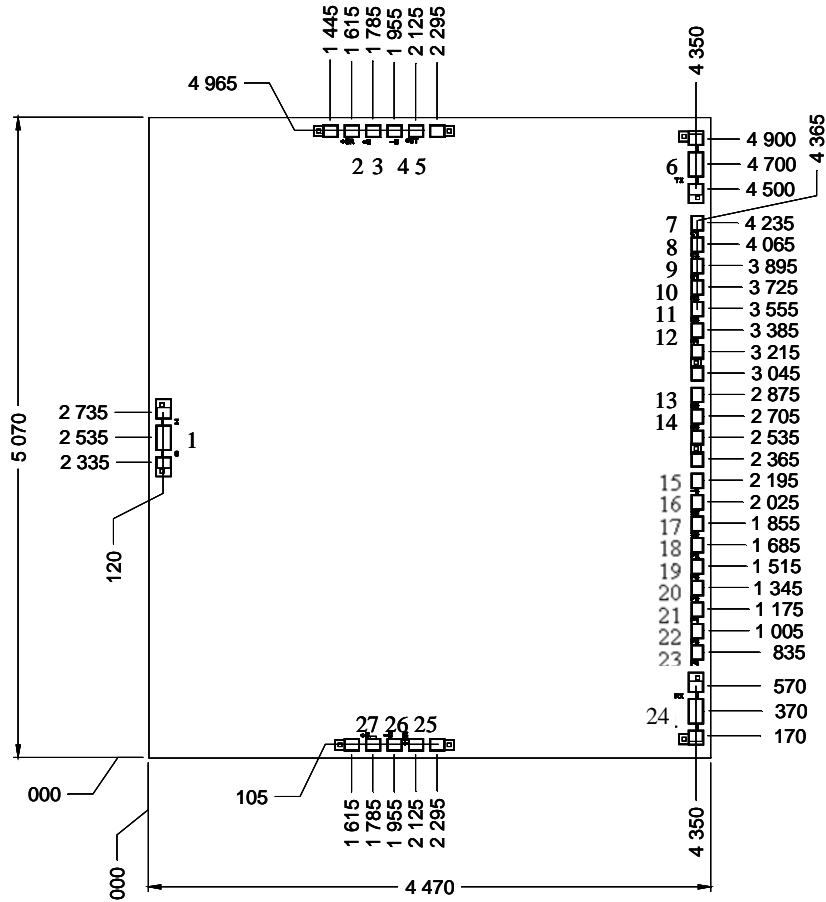
Tuning attenuation vs. tuning atten. state at 10 GHz  
 RX mode  
 Fine attenuator state 0, Phase shifter state 0



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## MMIC mechanical dimensions and pad allocation

*Preliminary*



UNITS :  $\mu\text{m}$   
Tol :  $\pm 35\mu\text{m}$

Chip thickness =  $100\mu\text{m} \pm 10 \mu\text{m}$ .

RF pads (1, 6, 24) =  $122 \times 200\mu\text{m}^2$

DC and control pads (2, 3, 4, 5, 7 to 23, 25, 26, 27) =  $120 \times 100\mu\text{m}^2$

| Pin number | Pad name | Description                    |
|------------|----------|--------------------------------|
| 1          | IO       | Input/Output RF: Rxout. Txin   |
| 2          | +5R      | +5V supply voltage Amplifier 3 |
| 3          | +5       | +5V supply voltage : interface |
| 4          | -5       | -5V supply voltage             |
| 5          | +5T      | +5V supply voltage Amplifier 4 |
| 6          | TX       | Output RF: TXout               |
| 7          | C1       | Coarse attenuator bit 1        |
| 8          | C2       | Coarse attenuator bit 2        |
| 9          | A1       | Attenuator bit 1               |
| 10         | A2       | Attenuator bit 2               |
| 11         | A3       | Attenuator bit 3               |
| 12         | A4       | Attenuator bit 4               |
| 13         | A5       | Attenuator bit 5               |
| 14         | A6       | Attenuator bit 6               |

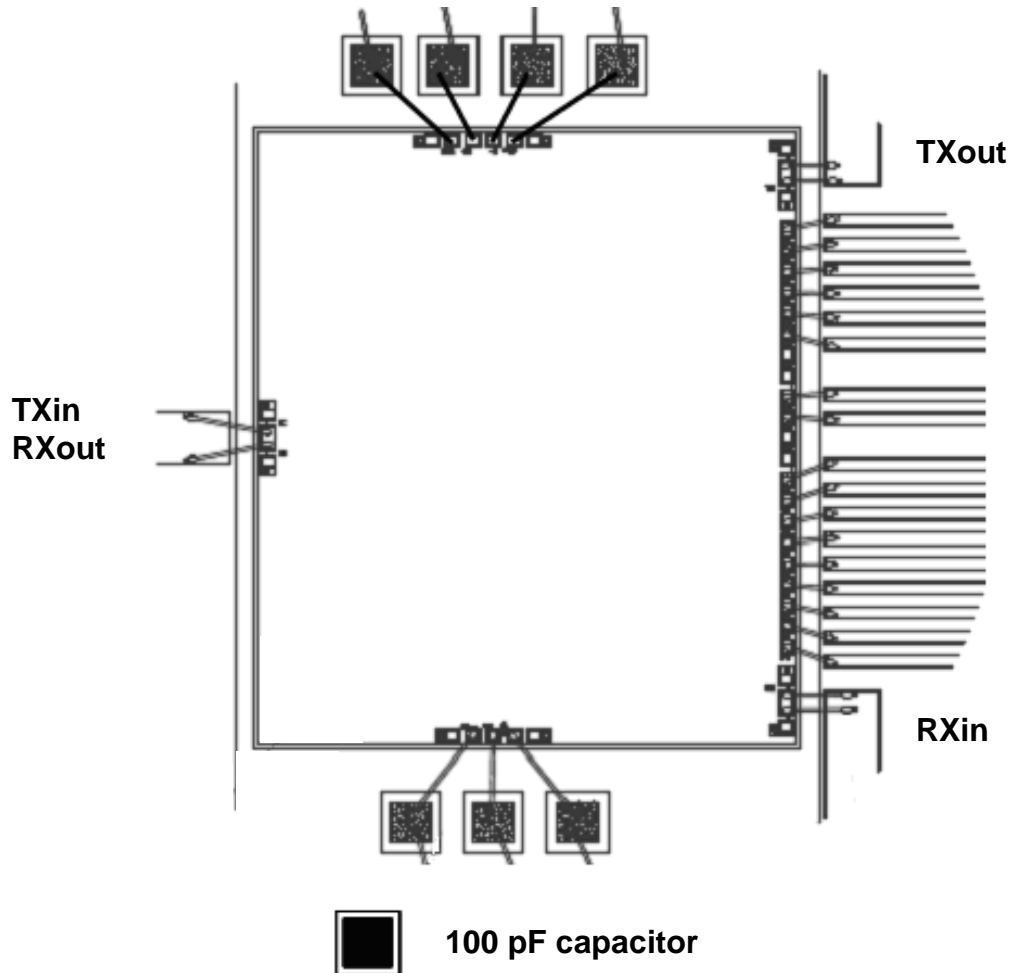
| Pin number | Pad name | Description                    |
|------------|----------|--------------------------------|
| 15         | -5       | -5V supply voltage: interface  |
| 16         | SA       | Switch bit 1                   |
| 17         | SB       | Switch bit 2                   |
| 18         | P1       | Phase shifter bit 1            |
| 19         | P2       | Phase shifter bit 2            |
| 20         | P3       | Phase shifter bit 3            |
| 21         | P4       | Phase shifter bit 4            |
| 22         | P5       | Phase shifter bit 5            |
| 23         | P6       | Phase shifter bit 6            |
| 24         | RX       | Input RF: RXin                 |
| 25         | +5R      | +5V supply voltage Amplifier 1 |
| 26         | -5       | -5V supply voltage             |
| 27         | +5       | +5V supply voltage Amplifier 2 |

*Preliminary*

**Bonding length recommendations**

| Port                                     | Connection   |
|--|--|
| TXin/RXout (1)<br>TXout (6)<br>RXin (24) | Inductance (Lbonding) = 0.3nH<br>two wires: diameter 25 μm, length 0.470μm |
| DC and Interface pads                    | Inductance (Lbonding) = 0.8nH<br>one wire: diameter 25 μm, length 1mm      |

**Recommended assembly diagram**



**Assembly diagram**

Note: Biasing pads 2-5-25-27 can be commonly connected to the +5V supply voltage

*Preliminary*

## OPERATING MODE

### BIASING CONDITIONS

#### *General Biasing conditions*

| Pin number | Pad name | Value     | Pin number | Pad name | Value     |
|------------|----------|-----------|------------|----------|-----------|
| 2          | +5R      | +5V       | 15         | -5       | -5V       |
| 3          | +5       | +5V       | 16         | SA       | 0 or 3.3V |
| 4          | -5       | -5V       | 17         | SB       | 0 or 3.3V |
| 5          | +5T      | +5V       | 18         | P1       | 0 or 3.3V |
| 7          | C1       | 0 or 3.3V | 19         | P2       | 0 or 3.3V |
| 8          | C2       | 0 or 3.3V | 20         | P3       | 0 or 3.3V |
| 9          | A1       | 0 or 3.3V | 21         | P4       | 0 or 3.3V |
| 10         | A2       | 0 or 3.3V | 22         | P5       | 0 or 3.3V |
| 11         | A3       | 0 or 3.3V | 23         | P6       | 0 or 3.3V |
| 12         | A4       | 0 or 3.3V | 25         | +5R      | +5V       |
| 13         | A5       | 0 or 3.3V | 26         | -5       | -5V       |
| 14         | A6       | 0 or 3.3V | 27         | +5       | +5V       |

*General biasing conditions*

### SWITCHES CONTROL TABLE

Voltages to apply on the pads SA SB:

|                           | SA  | SB  |
|---------------------------|-----|-----|
| Adaptative Isolation mode | 3.3 | 3.3 |
| RX path                   | 3.3 | 0   |
| TX path                   | 0   | 3.3 |
| Not used                  | 0   | 0   |

*Switch control table*

**Note:** When the MFC is used in adaptative isolation mode, it presents a matched load to the RF access pad RXin/TXout

### TUNING ATTENUATOR CONTROL TABLE

Voltages to apply on the pads C1 C2:

| state | Att (dB) | C2  | C1  |
|-------|----------|-----|-----|
| 0     | 0        | 0   | 0   |
| 1     | 2        | 0   | 3.3 |
| 2     | 4        | 3.3 | 0   |
| 3     | 6        | 3.3 | 3.3 |

*Coarse bit control table*

*Preliminary*

**ATTENUATOR CONTROL TABLE**

Voltage to apply on the pads A1 to A6:

| state | Att (dB) | A6  | A5  | A4  | A3  | A2  | A1  |
|-------|----------|-----|-----|-----|-----|-----|-----|
| 0     | 0        | 0   | 0   | 0   | 0   | 0   | 0   |
| 1     | 0.55     | 0   | 0   | 0   | 0   | 0   | 3.3 |
| 2     | 1.1      | 0   | 0   | 0   | 0   | 3.3 | 0   |
| 3     | 1.65     | 0   | 0   | 0   | 0   | 3.3 | 3.3 |
| 4     | 2.2      | 0   | 0   | 0   | 3.3 | 0   | 0   |
| 5     | 2.75     | 0   | 0   | 0   | 3.3 | 0   | 3.3 |
| 6     | 3.3      | 0   | 0   | 0   | 3.3 | 3.3 | 0   |
| 7     | 3.85     | 0   | 0   | 0   | 3.3 | 3.3 | 3.3 |
| 8     | 4.4      | 0   | 0   | 3.3 | 0   | 0   | 0   |
| 9     | 4.95     | 0   | 0   | 3.3 | 0   | 0   | 3.3 |
| 10    | 5.5      | 0   | 0   | 3.3 | 0   | 3.3 | 0   |
| 11    | 6.05     | 0   | 0   | 3.3 | 0   | 3.3 | 3.3 |
| 12    | 6.6      | 0   | 0   | 3.3 | 3.3 | 0   | 0   |
| 13    | 7.15     | 0   | 0   | 3.3 | 3.3 | 0   | 3.3 |
| 14    | 7.7      | 0   | 0   | 3.3 | 3.3 | 3.3 | 0   |
| 15    | 8.25     | 0   | 0   | 3.3 | 3.3 | 3.3 | 3.3 |
| 16    | 8.8      | 0   | 3.3 | 0   | 0   | 0   | 0   |
| 17    | 9.35     | 0   | 3.3 | 0   | 0   | 0   | 3.3 |
| 18    | 9.9      | 0   | 3.3 | 0   | 0   | 3.3 | 0   |
| 19    | 10.45    | 0   | 3.3 | 0   | 0   | 3.3 | 3.3 |
| 20    | 11       | 0   | 3.3 | 0   | 3.3 | 0   | 0   |
| 21    | 11.55    | 0   | 3.3 | 0   | 3.3 | 0   | 3.3 |
| 22    | 12.1     | 0   | 3.3 | 0   | 3.3 | 3.3 | 0   |
| 23    | 12.65    | 0   | 3.3 | 0   | 3.3 | 3.3 | 3.3 |
| 24    | 13.2     | 0   | 3.3 | 3.3 | 0   | 0   | 0   |
| 25    | 13.75    | 0   | 3.3 | 3.3 | 0   | 0   | 3.3 |
| 26    | 14.3     | 0   | 3.3 | 3.3 | 0   | 3.3 | 0   |
| 27    | 14.85    | 0   | 3.3 | 3.3 | 0   | 3.3 | 3.3 |
| 28    | 15.4     | 0   | 3.3 | 3.3 | 3.3 | 0   | 0   |
| 29    | 15.95    | 0   | 3.3 | 3.3 | 3.3 | 0   | 3.3 |
| 30    | 16.5     | 0   | 3.3 | 3.3 | 3.3 | 3.3 | 0   |
| 31    | 17.05    | 0   | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| 32    | 17.6     | 3.3 | 0   | 0   | 0   | 0   | 0   |

|    |       |     |     |     |     |     |     |
|----|-------|-----|-----|-----|-----|-----|-----|
| 33 | 18.15 | 3.3 | 0   | 0   | 0   | 0   | 3.3 |
| 34 | 18.7  | 3.3 | 0   | 0   | 0   | 3.3 | 0   |
| 35 | 19.25 | 3.3 | 0   | 0   | 0   | 3.3 | 3.3 |
| 36 | 19.8  | 3.3 | 0   | 0   | 3.3 | 0   | 0   |
| 37 | 20.35 | 3.3 | 0   | 0   | 3.3 | 0   | 3.3 |
| 38 | 20.9  | 3.3 | 0   | 0   | 3.3 | 3.3 | 0   |
| 39 | 21.45 | 3.3 | 0   | 0   | 3.3 | 3.3 | 3.3 |
| 40 | 22    | 3.3 | 0   | 3.3 | 0   | 0   | 0   |
| 41 | 22.55 | 3.3 | 0   | 3.3 | 0   | 0   | 3.3 |
| 42 | 23.1  | 3.3 | 0   | 3.3 | 0   | 3.3 | 0   |
| 43 | 23.65 | 3.3 | 0   | 3.3 | 0   | 3.3 | 3.3 |
| 44 | 24.2  | 3.3 | 0   | 3.3 | 3.3 | 0   | 0   |
| 45 | 24.75 | 3.3 | 0   | 3.3 | 3.3 | 0   | 3.3 |
| 46 | 25.3  | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 0   |
| 47 | 25.85 | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 3.3 |
| 48 | 26.4  | 3.3 | 3.3 | 0   | 0   | 0   | 0   |
| 49 | 26.95 | 3.3 | 3.3 | 0   | 0   | 0   | 3.3 |
| 50 | 27.5  | 3.3 | 3.3 | 0   | 0   | 3.3 | 0   |
| 51 | 28.05 | 3.3 | 3.3 | 0   | 0   | 3.3 | 3.3 |
| 52 | 28.6  | 3.3 | 3.3 | 0   | 3.3 | 0   | 0   |
| 53 | 29.15 | 3.3 | 3.3 | 0   | 3.3 | 0   | 3.3 |
| 54 | 29.7  | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 0   |
| 55 | 30.25 | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 3.3 |
| 56 | 30.8  | 3.3 | 3.3 | 3.3 | 0   | 0   | 0   |
| 57 | 31.35 | 3.3 | 3.3 | 3.3 | 0   | 0   | 3.3 |
| 58 | 31.9  | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 0   |
| 59 | 32.45 | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 3.3 |
| 60 | 33    | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 0   |
| 61 | 33.55 | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 3.3 |
| 62 | 34.1  | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 0   |
| 63 | 34.65 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |

*Fine attenuator control table*

*Preliminary*

## PHASE SHIFTER CONTROL TABLE

Voltage to apply on the pads P1 to P6:

| state | Phase (deg) | P6  | P5  | P4  | P3  | P2  | P1  |
|-------|-------------|-----|-----|-----|-----|-----|-----|
| 0     | 0           | 0   | 0   | 0   | 0   | 0   | 0   |
| 1     | -5.625      | 0   | 0   | 0   | 0   | 0   | 3.3 |
| 2     | -11.25      | 0   | 0   | 0   | 0   | 3.3 | 0   |
| 3     | -16.875     | 0   | 0   | 0   | 0   | 3.3 | 3.3 |
| 4     | -22.5       | 0   | 0   | 0   | 3.3 | 0   | 0   |
| 5     | -28.125     | 0   | 0   | 0   | 3.3 | 0   | 3.3 |
| 6     | -33.75      | 0   | 0   | 0   | 3.3 | 3.3 | 0   |
| 7     | -39.375     | 0   | 0   | 0   | 3.3 | 3.3 | 3.3 |
| 8     | -45         | 0   | 0   | 3.3 | 0   | 0   | 0   |
| 9     | -50.625     | 0   | 0   | 3.3 | 0   | 0   | 3.3 |
| 10    | -56.25      | 0   | 0   | 3.3 | 0   | 3.3 | 0   |
| 11    | -61.875     | 0   | 0   | 3.3 | 0   | 3.3 | 3.3 |
| 12    | -67.5       | 0   | 0   | 3.3 | 3.3 | 0   | 0   |
| 13    | -73.125     | 0   | 0   | 3.3 | 3.3 | 0   | 3.3 |
| 14    | -78.75      | 0   | 0   | 3.3 | 3.3 | 3.3 | 0   |
| 15    | -84.375     | 0   | 0   | 3.3 | 3.3 | 3.3 | 3.3 |
| 16    | -90         | 0   | 3.3 | 0   | 0   | 0   | 0   |
| 17    | -95.625     | 0   | 3.3 | 0   | 0   | 0   | 3.3 |
| 18    | -101.25     | 0   | 3.3 | 0   | 0   | 3.3 | 0   |
| 19    | -106.875    | 0   | 3.3 | 0   | 0   | 3.3 | 3.3 |
| 20    | -112.5      | 0   | 3.3 | 0   | 3.3 | 0   | 0   |
| 21    | -118.125    | 0   | 3.3 | 0   | 3.3 | 0   | 3.3 |
| 22    | -123.75     | 0   | 3.3 | 0   | 3.3 | 3.3 | 0   |
| 23    | -129.375    | 0   | 3.3 | 0   | 3.3 | 3.3 | 3.3 |
| 24    | -135        | 0   | 3.3 | 3.3 | 0   | 0   | 0   |
| 25    | -140.625    | 0   | 3.3 | 3.3 | 0   | 0   | 3.3 |
| 26    | -146.25     | 0   | 3.3 | 3.3 | 0   | 3.3 | 0   |
| 27    | -151.875    | 0   | 3.3 | 3.3 | 0   | 3.3 | 3.3 |
| 28    | -157.5      | 0   | 3.3 | 3.3 | 3.3 | 0   | 0   |
| 29    | -163.125    | 0   | 3.3 | 3.3 | 3.3 | 0   | 3.3 |
| 30    | -168.75     | 0   | 3.3 | 3.3 | 3.3 | 3.3 | 0   |
| 31    | -174.375    | 0   | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| 32    | -180        | 3.3 | 0   | 0   | 0   | 0   | 0   |

|    |          |     |     |     |     |     |     |
|----|----------|-----|-----|-----|-----|-----|-----|
| 33 | -185.625 | 3.3 | 0   | 0   | 0   | 0   | 3.3 |
| 34 | -191.25  | 3.3 | 0   | 0   | 0   | 0   | 3.3 |
| 35 | -196.875 | 3.3 | 0   | 0   | 0   | 0   | 3.3 |
| 36 | -202.5   | 3.3 | 0   | 0   | 0   | 3.3 | 0   |
| 37 | -208.125 | 3.3 | 0   | 0   | 0   | 3.3 | 0   |
| 38 | -213.75  | 3.3 | 0   | 0   | 0   | 3.3 | 3.3 |
| 39 | -219.375 | 3.3 | 0   | 0   | 0   | 3.3 | 3.3 |
| 40 | -225     | 3.3 | 0   | 3.3 | 0   | 0   | 0   |
| 41 | -230.625 | 3.3 | 0   | 3.3 | 0   | 0   | 3.3 |
| 42 | -236.25  | 3.3 | 0   | 3.3 | 0   | 3.3 | 0   |
| 43 | -241.875 | 3.3 | 0   | 3.3 | 0   | 3.3 | 3.3 |
| 44 | -247.5   | 3.3 | 0   | 3.3 | 3.3 | 0   | 0   |
| 45 | -253.125 | 3.3 | 0   | 3.3 | 3.3 | 0   | 3.3 |
| 46 | -258.75  | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 0   |
| 47 | -264.375 | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 3.3 |
| 48 | -270     | 3.3 | 3.3 | 0   | 0   | 0   | 0   |
| 49 | -275.625 | 3.3 | 3.3 | 0   | 0   | 0   | 3.3 |
| 50 | -281.25  | 3.3 | 3.3 | 0   | 0   | 3.3 | 0   |
| 51 | -286.875 | 3.3 | 3.3 | 0   | 0   | 3.3 | 3.3 |
| 52 | -292.5   | 3.3 | 3.3 | 0   | 3.3 | 0   | 0   |
| 53 | -298.125 | 3.3 | 3.3 | 0   | 3.3 | 0   | 3.3 |
| 54 | -303.75  | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 0   |
| 55 | -309.375 | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 3.3 |
| 56 | -315     | 3.3 | 3.3 | 3.3 | 0   | 0   | 0   |
| 57 | -320.625 | 3.3 | 3.3 | 3.3 | 0   | 0   | 3.3 |
| 58 | -326.25  | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 0   |
| 59 | -331.875 | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 3.3 |
| 60 | -337.5   | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 0   |
| 61 | -343.125 | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 3.3 |
| 62 | -348.75  | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 0   |
| 63 | -354.375 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |

Phase shifter control table

## Ordering Information

Chip form : CHC3014-99F/00

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