

## X-band Core Chip

### GaAs Monolithic Microwave IC

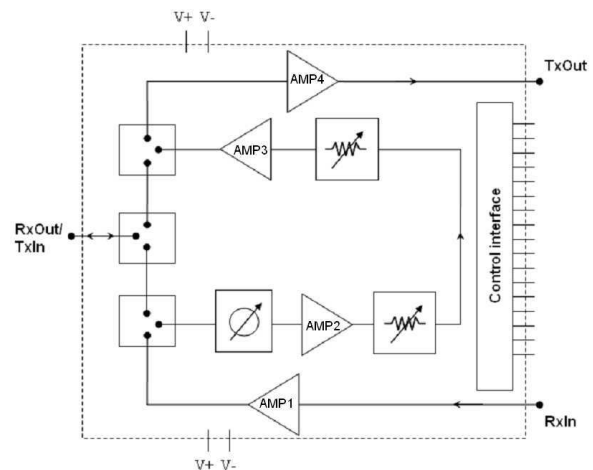
#### Description

The CHC3014-99F 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 0.25µm pHEMT process, including via holes through the substrate.

It is available in chip form.



#### Main Features

- Operating frequency range: 8 -12GHz
- Receive path linear gain: 13.5dB
- Transmit path linear gain: 25dB
- 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

Tamb.= +25°C, 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   |
| P <sub>-1dB</sub> Rx | Output power at RX <sub>OUT</sub> @1dB gain comp. |     | 16.5 |     | dBm  |
| Psat Tx              | Output power at TX <sub>OUT</sub> at saturation   |     | 20   |     | dBm  |
| NF                   | Noise figure in Rx mode                           |     | 5.8  |     | dB   |

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

## Main Characteristics (1/2)

Tamb.= +25°C

| Symbol                                    | Parameter   | Min  | Typ   | Max | Unit |
|---|---|------|-------|-----|------|
| Freq                                      | Operating frequency   | 8    |       | 12  | GHz  |
| <b>Mode Rx</b>                            |   |      |       |     |      |
| GI Rx                                     | Linear gain in Rx mode at reference state <sup>(1)</sup>  | 11.5 | 13.5  |     | dB   |
| S11 Rx                                    | Input Return Loss in Rx mode  |      | -14   |     | dB   |
| S22 Rx                                    | Output Return Loss in Rx mode   |      | -18   |     | dB   |
| NF  | Noise figure in Rx mode <sup>(2)</sup>  |      | 5.8   |     | dB   |
| P <sub>-1dB</sub> Rx                      | Output power at R <sub>XOUT</sub> at 1dB gain comp.   |      | 16.5  |     | dBm  |
| <b>Mode Tx</b>                            |   |      |       |     |      |
| GI Tx                                     | Linear gain in Tx mode at reference state <sup>(1)</sup>  | 22   | 25    |     | dB   |
| S11 Tx                                    | Input Return Loss in Tx mode  |      | -14   |     | dB   |
| S22 Tx                                    | Output Return Loss in Tx mode   |      | -12   |     | dB   |
| PIN Tx                                    | Input power range in Tx saturated mode  | 0    |       | 15  | dBm  |
| Psat Tx                                   | Output power at T <sub>XOUT</sub> in saturated mode   |      | 20    |     | dBm  |
| <b>Isolated Mode <sup>(3)</sup></b>       |   |      |       |     |      |
| S11 <sub>ISO.</sub>                       | Return Loss at R <sub>Xin</sub> /T <sub>Xout</sub>  |      | -15   |     | dB   |
| <b>6 bit Phase shifter <sup>(4)</sup></b> |   |      |       |     |      |
|   | Phase shift elementary step   |      | 5.625 |     | °    |
| PPE                                       | Peak phase error<br>(Rx, Tx, fine attenuator state < 33<br>tuning attenuator state 1)<br>8GHz-8.5GHz<br>8.5GHz-11.5GHz<br>11.5GHz-12GHz |      | 4 ± 6 |     | °    |
|   |   |      | 0 ± 6 |     |      |
|   |   |      | 4 ± 6 |     |      |
| Rms_pe                                    | RMS phase error<br>(Rx, Tx, fine attenuator state < 33<br>tuning attenuator state 1)<br>8GHz-8.5GHz<br>8.5GHz-11.5GHz<br>11.5GHz-12GHz  |      | 2.5   |     | °    |
|   |   |      | 2     |     |      |
|   |   |      | 2.5   |     |      |
| Ampvar                                    | Amplitude variation<br>(Rx, Tx, fine attenuator state < 33<br>tuning attenuator state 1)  |      | 0 ± 1 |     | dB   |
| Rms Ampvar                                | RMS Amplitude variation<br>(Rx, Tx, fine attenuator state < 33<br>tuning attenuator state 1)  |      | 0.3   |     | dB   |

(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

## Main Characteristics (2/2)

T<sub>amb.</sub> = +25°C

| Symbol  | Parameter   | Min | Typ                                      | Max | Unit |
|---|---|-----|--|-----|------|
| <b>6 bit Fine Attenuator</b> <sup>(4)</sup>   |   |     | 34.65                                    |     | 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   |
| Phi_var <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_Phi<br>var                                | RMS Phase variation<br>(Rx, all phase shifter states<br>tuning attenuator state 1)  |     | 2  |     | °    |
| <b>2 bit Tuning Attenuator</b> <sup>(5)</sup> |   |     | 6  |     | dB   |
|   | Tuning Attenuator elementary step   |     | 2  |     | dB   |
| Att_Err <sub>TB</sub>                         | Tuning attenuation error  |     | ± 0.3                                    |     | dB   |
| Phi_var <sub>TB</sub>                         | Phase variation of tuning attenuator  |     | ± 2                                      |     | °    |
| <b>Biasing</b> <sup>(6)</sup>                 |   |     |  |     |      |
| V+  | Positive supply voltage   |     | 5  |     | V    |
| V-  | Negative supply voltage   |     | -5                                       |     | V    |
| TI_Low  | Control voltage low level   | 0   |  | 0.4 | V    |
| TI_High                                       | Control voltage high level  | 2.4 | +3.3 / +5                                | 7.0 | V    |
| I <sub>+5_Rx</sub>                            | Biasing current in RX mode  |     | 350                                      |     | mA   |
| I <sub>+5_Tx</sub>                            | Biasing current in TX mode  |     | 350 <sup>(7)</sup><br>470 <sup>(8)</sup> |     | mA   |
| I <sub>+5</sub><br>interface                  | Control interface DC current  |     | 25                                       |     | mA   |
| I <sub>-5</sub>                               | Negative DC current   |     | -50                                      |     | mA   |

(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

## Definitions

Phase(i,j) = Phase\_S21 in degree  
dB\_S21(i,j) = dB\_S21 in dB

i: Phase state index,  $0 \leq i \leq 63$   
j: Fine attenuation state index,  $0 \leq j \leq 63$

### Peak Phase Error (PPE)

$PPE(i,j) = \text{Measured\_Phase}(S21)@state(i,j) - \text{Measured\_Phase}(S21)@state(0,j) - \text{theoreticalPhaseValue}@State(i,j)$

### Amplitude Variation (Ampvar)

$Ampvar(i,j) = \text{Measured\_dB\_S21}@state(i,j) - \text{Measured\_dB\_S21}@state(0,j)$   
(i) is the phase state and in the range [0:63]

The translation of Ampvar(i,j) from dB to linear is given by:  $Ampvar(i,j)_{lin} = 10^{\frac{Amp\ var(i,j)}{20}}$

### Attenuation Error (Att\_err\_att)

$Att\_err(i,j) = \text{Measured\_dB\_S21}@state(i,j) - \text{Measured\_dB\_S21}@state(i,0) - \text{theoretical\_dB\_S21}@state(i,j)$

The translation of Att\_err(i,j) from dB to linear is given by:  $Att\_err(i,j)_{lin} = 10^{\frac{Att\_err(i,j)}{20}}$

### Phase variation (Phivar\_att)

$Phivar(i,j) = \text{Measured\_Phase}(S21)@state(i,j) - \text{Measured\_Phase}(S21)@state(i,0)$

### RMS Peak Phase Error (Rms\_pe)

$$Rms\_pe = \sqrt{\frac{\sum_{i=0}^{63} (PPE(i, j) - \overline{PPE})^2}{64}}$$

Where  $\overline{PPE} = \frac{\sum_{i=0}^{63} PPE(i, j)}{64}$

### RMS Amplitude Variation (Rms\_Ampvar)

$$Rms\_Ampvar = 20 \log \left( 1 + \sqrt{\frac{1}{64} \cdot \sum_{i=0}^{63} (1 - Amp\ var(i, j)_{lin})^2} \right) \text{ (dB)}$$

**RMS Attenuation Error (Rms\_att)**

$$Rms\_att = 20 \log \left( 1 + \sqrt{\frac{1}{64} \cdot \sum_{i=0}^{63} (1 - Att\_err(i, j)\_lin)^2} \right) \text{ (dB)}$$

**RMS Phase variation (Rms\_Phivar)**

$$Rms\_Phivar = \sqrt{\frac{\sum_{j=0}^{63} (Phi\ var(i, j))^2}{64}} \quad (9)$$

**Absolute Maximum Ratings**

T<sub>amb.</sub> = +25°C <sup>(1)</sup>

| Symbol                       | Parameter  | Values      | Unit |
|------------------------------|--|-------------|------|
| V+                           | Maximum positive bias voltage                          | 6           | V    |
| V-                           | Negative voltage range                                 | -6 to -4    | V    |
| P <sub>RF<sub>RX</sub></sub> | Maximum peak input power overdrive in Rx mode          | 16          | dBm  |
| P <sub>RF<sub>TX</sub></sub> | Maximum peak input power overdrive in Tx mode          | 16          | dBm  |
| Ai                           | CTRL voltage (TI <sub>low</sub> , TI <sub>high</sub> ) | -2, +8      | V    |
| Tch                          | Maximum channel temperature <sup>(2)</sup>             | 175         | °C   |
| Ta                           | Operating temperature range                            | -40 to +85  | °C   |
| Tstg                         | Storage temperature range                              | -55 to +125 | °C   |

<sup>(1)</sup> Operation of this device above any one of these parameters may cause permanent damage.

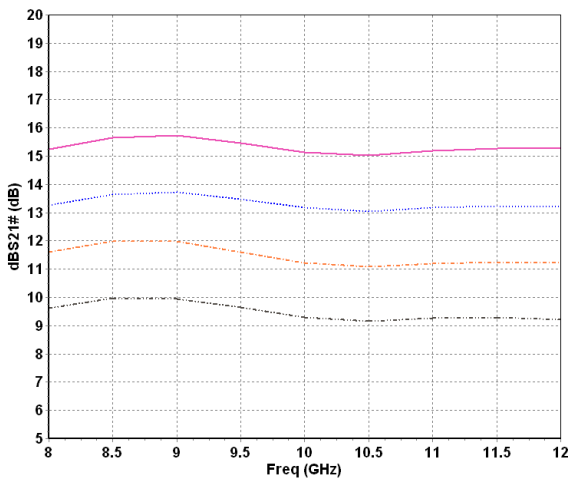
<sup>(2)</sup> Thermal Resistance channel to ground paddle = 40°C /W for T = +85°C

## Typical on wafer Measurements

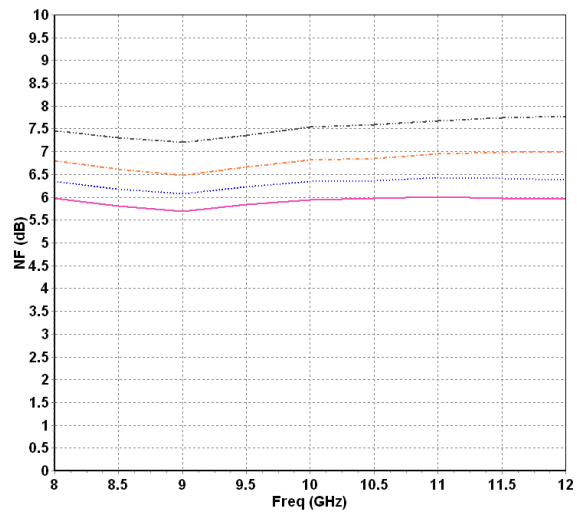
Tamb.= +25°C

### [S] parameters in Rx mode

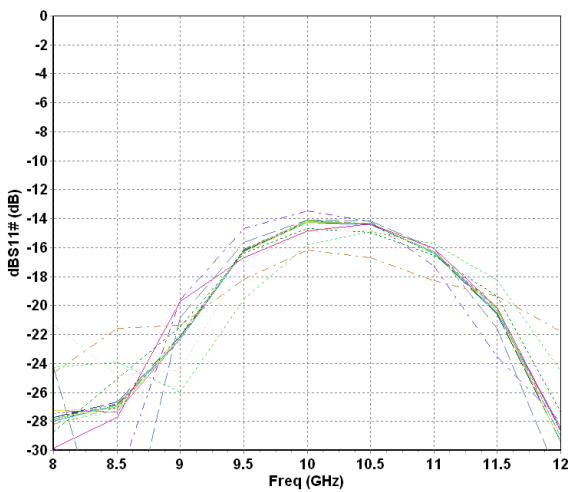
S21 vs. Frequency  
 Tuning attenuator states 0-1-2-3  
 Fine attenuator state 0, Phase shifter state 0



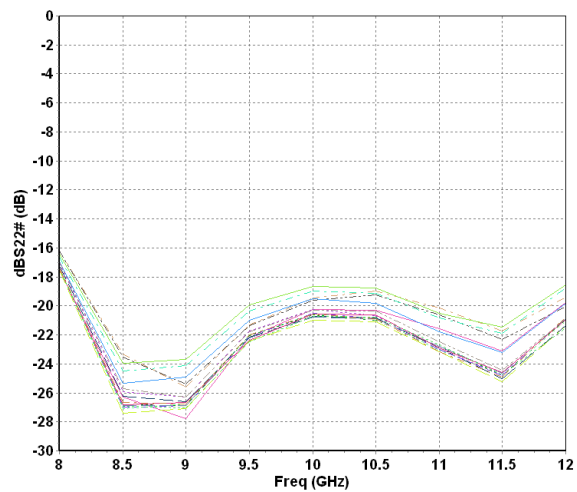
Noise Factor vs. Frequency  
 Tuning attenuator states 0-1-2-3  
 Fine attenuator state 0, Phase shifter state 0



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

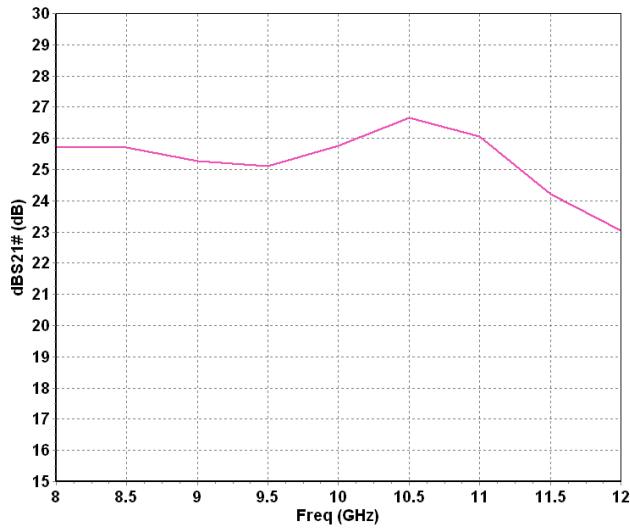


Typical on wafer Measurements

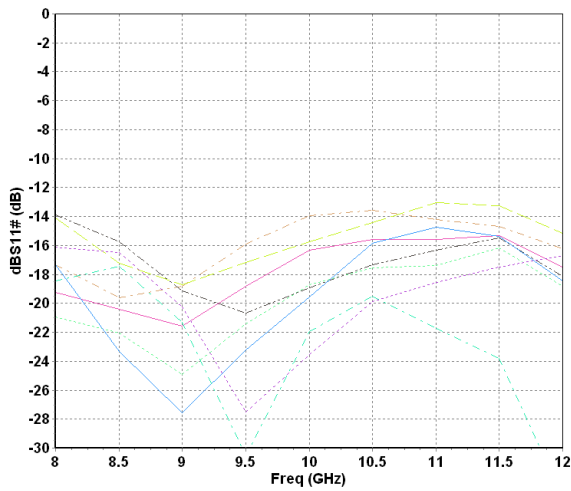
Tamb.= +25°C

[S] parameters in Tx mode

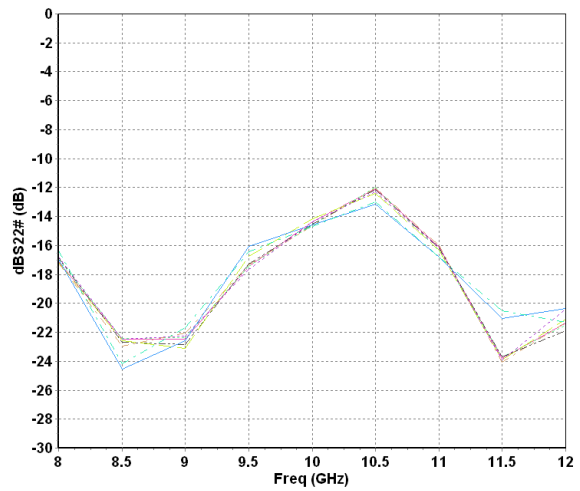
S21 vs. Frequency  
 Tuning attenuator state 1  
 Fine attenuator state 0, Phase shifter state 0



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

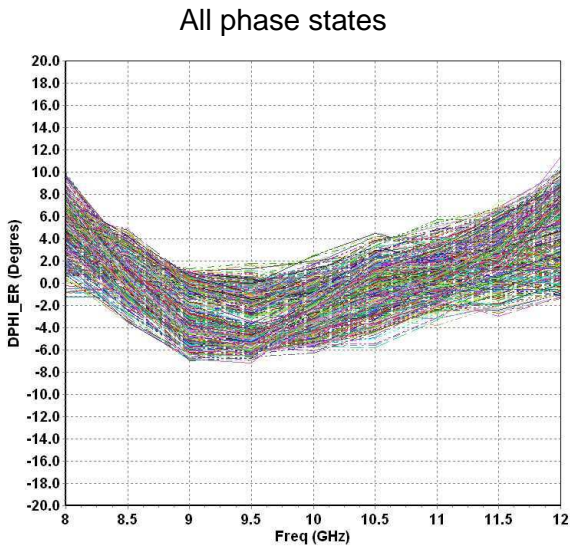


## Typical on wafer Measurements

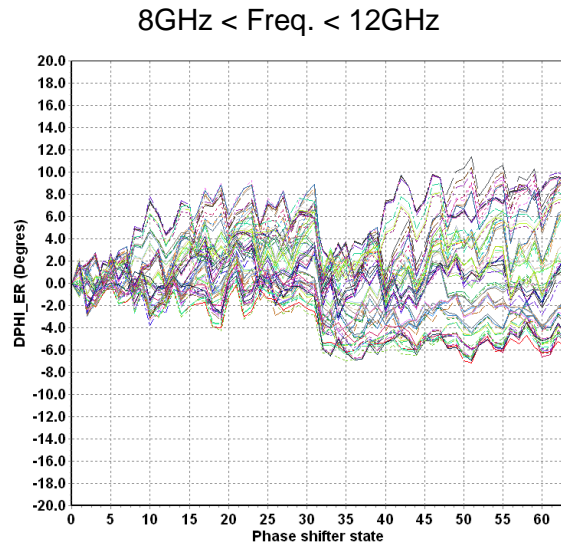
Tamb.= +25°C

### Phase shifter performances: Phase error Rx and Tx mode

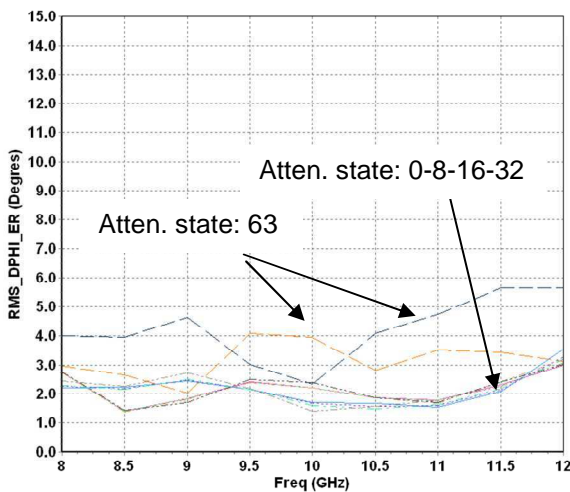
Phase error vs. frequency  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32



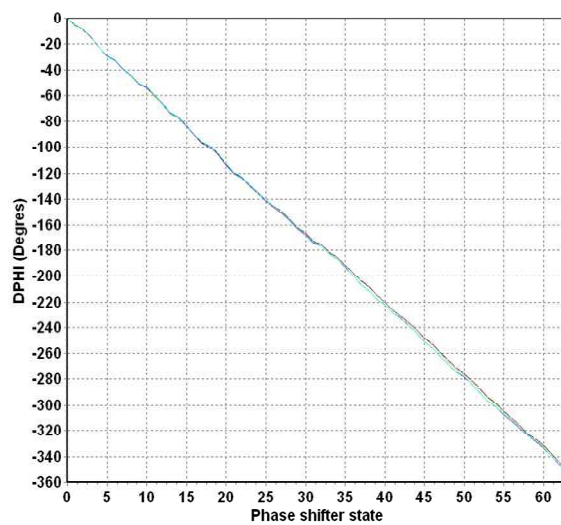
Phase error vs. phase state  
for attenuation states 0, 8, 16, 32



Phase error RMS



Phase shift vs. phase shifter state  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32  
Freq. = 10GHz



Typical on wafer Measurements

Tamb.= +25°C

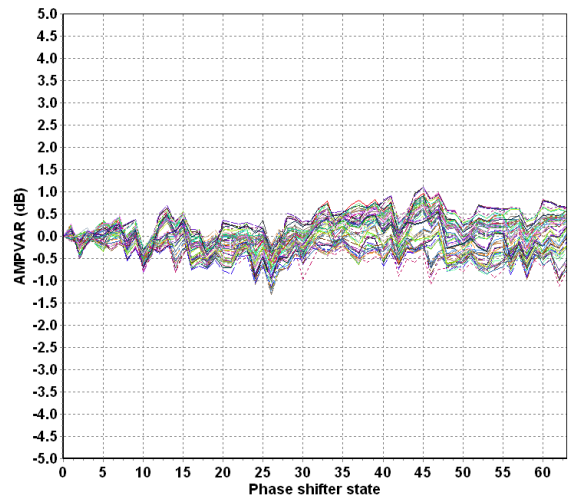
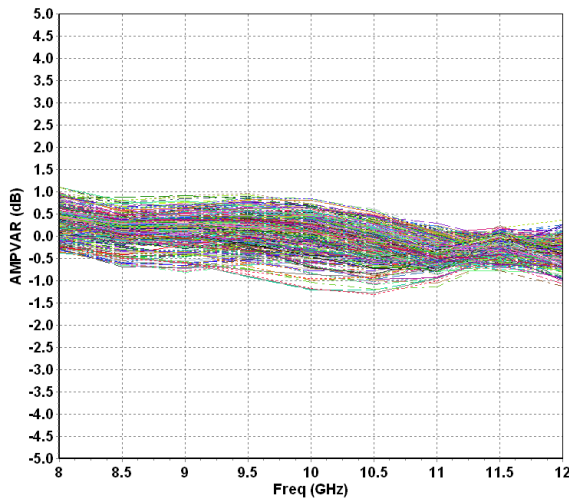
Phase shifter performances: Amplitude variation  
Rx and Tx mode

Amplitude variation vs. frequency  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32

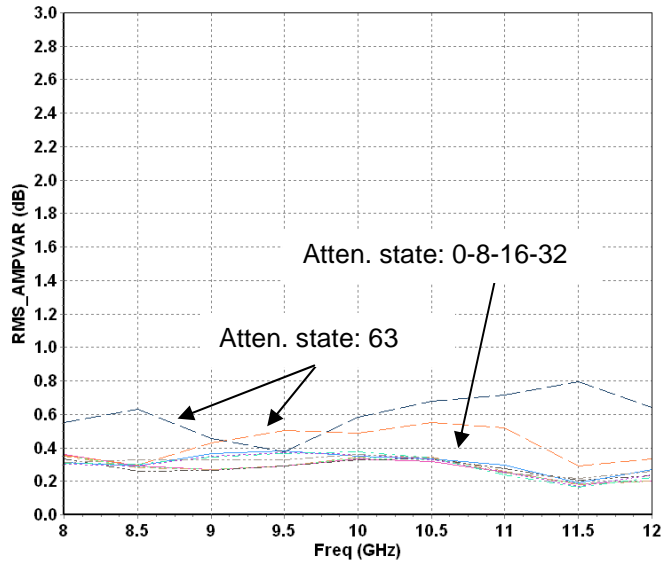
Amplitude variation vs. phase state  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32

All phase states

8GHz < Freq. < 12GHz



Amplitude variation RMS  
Tuning attenuator state 1  
Fine attenuator states 0-8-16-32

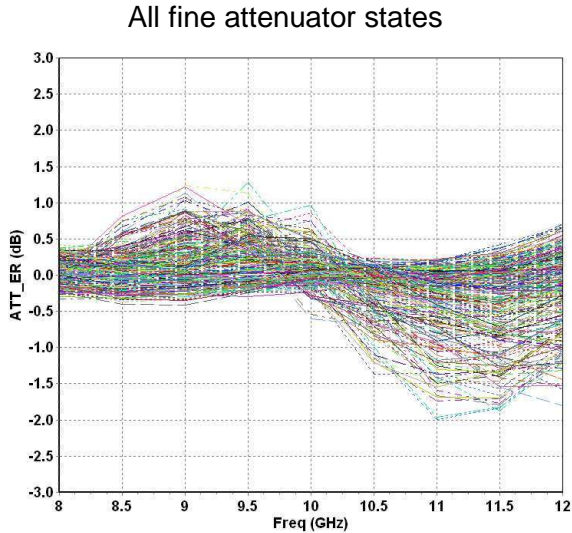


## Typical on wafer Measurements

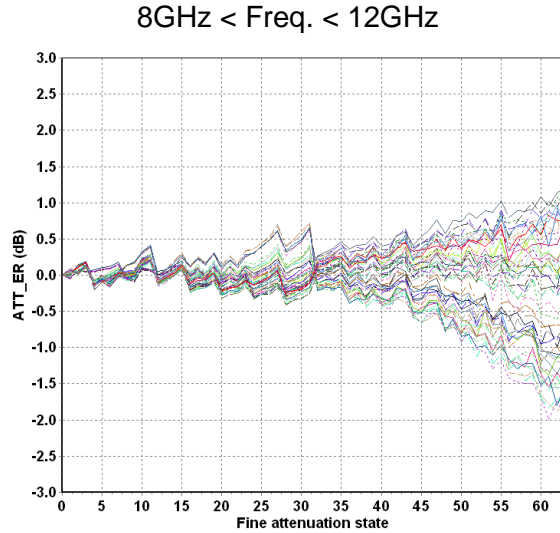
Tamb.= +25°C

### Fine Attenuator performances: Attenuation error Rx mode

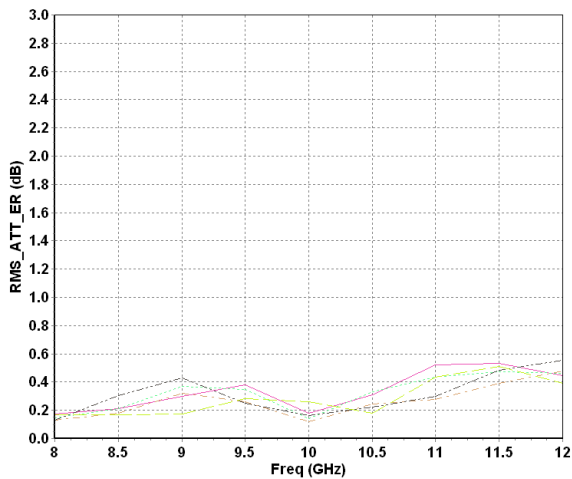
Attenuation error vs. freq.  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63



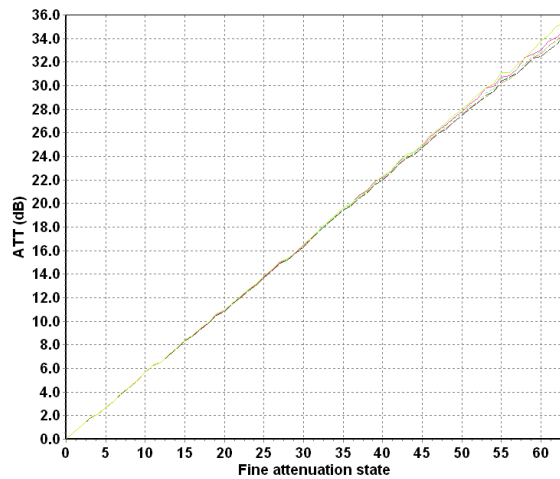
Attenuation error vs. atten. state  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63



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



Attenuation vs. Fine attenuator state  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63  
Freq. = 10GHz

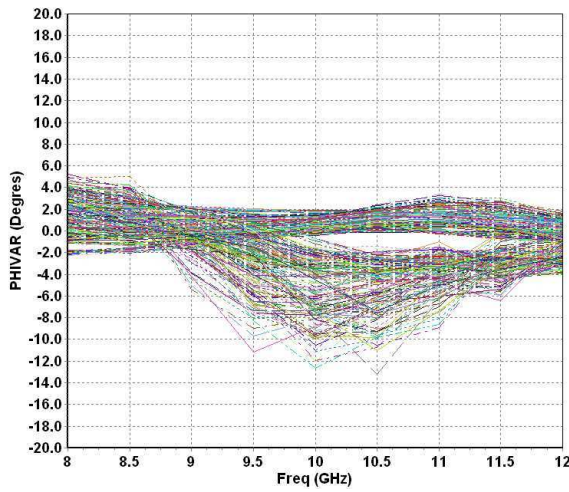


Typical on wafer Measurements

Tamb.= +25°C

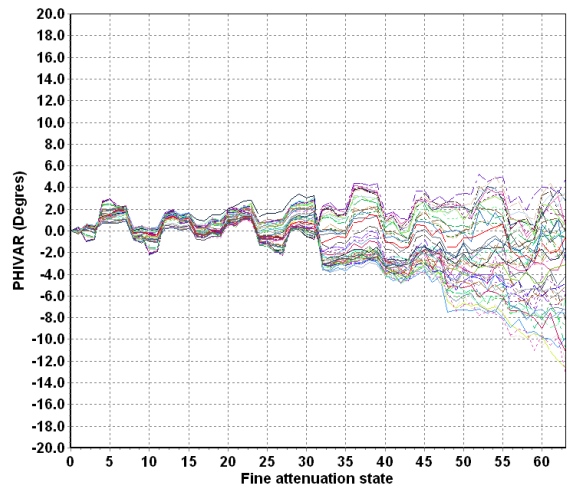
Fine Attenuator performances: phase variation  
Rx mode

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

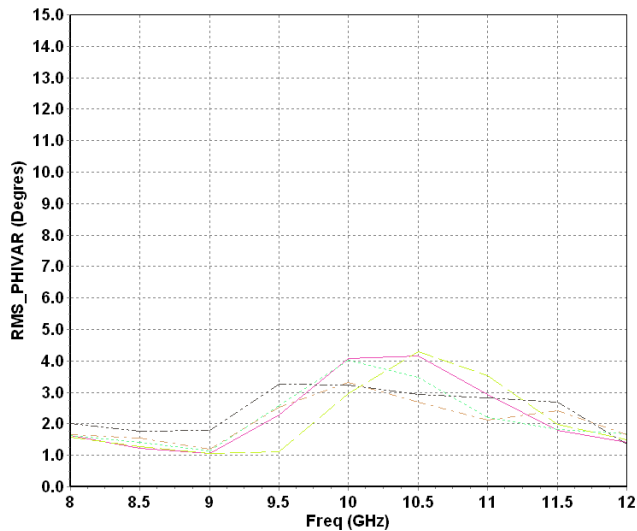


Phase variation vs. atten. state  
Tuning attenuator state 1  
Phase shifter states 0-8-16-32-63

8GHz < Freq. < 12GHz



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

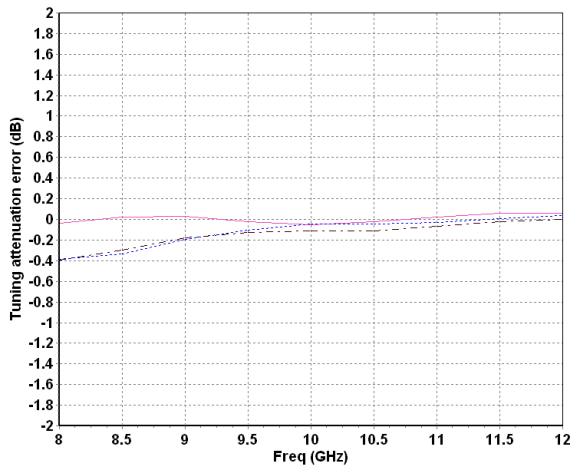


## Typical on wafer Measurements

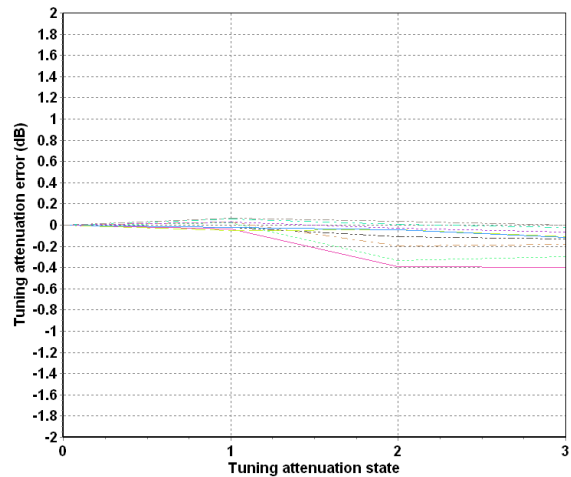
Tamb.= +25°C

### Tuning Attenuator performances Rx mode

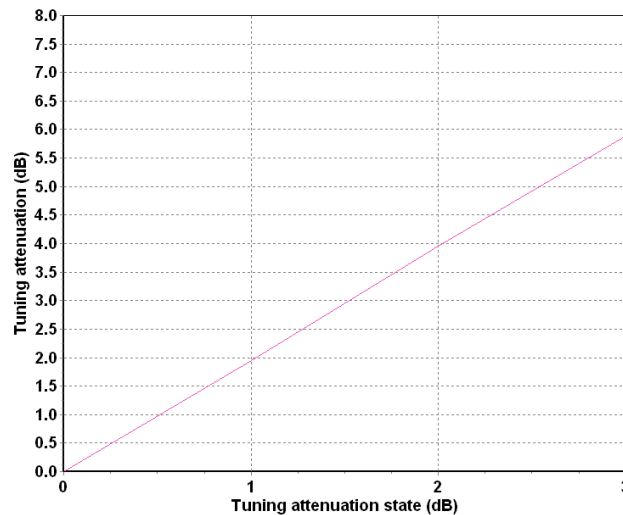
Tuning attenuation error vs. freq.  
Fine attenuator state 0, Phase shifter state 0  
Attenuation states 0–1–2–3



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



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



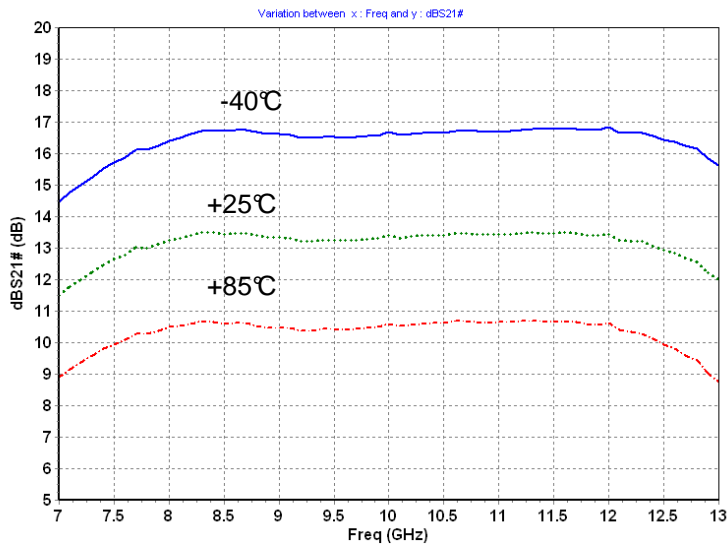
**Typical Test Fixture Measurements in Temperature**

Tamb = [-40, +25, 85] °C

These values are representative of de-embedded onboard measurements as defined on the drawing 98658.

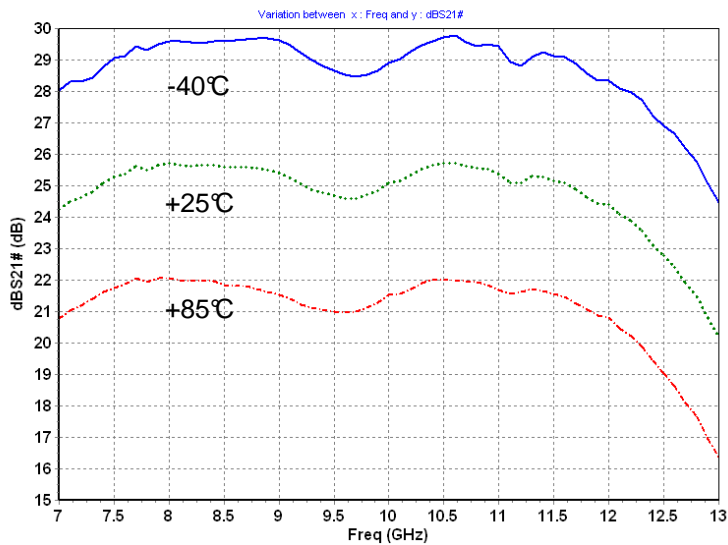
**[S] parameter in RX mode**

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

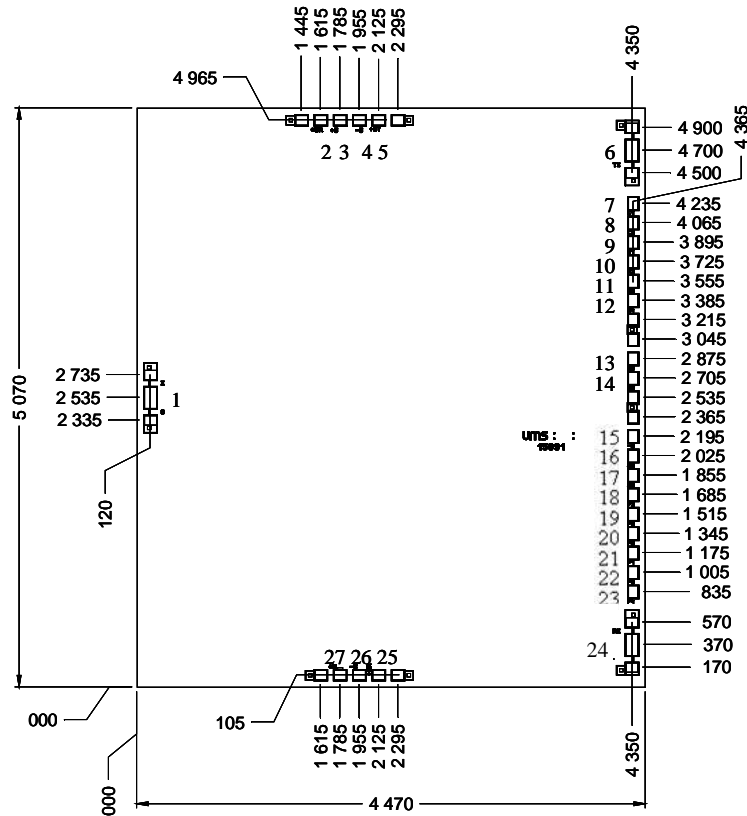


**[S] parameter in TX mode**

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



## Mechanical data



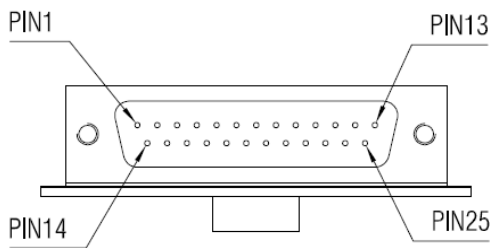
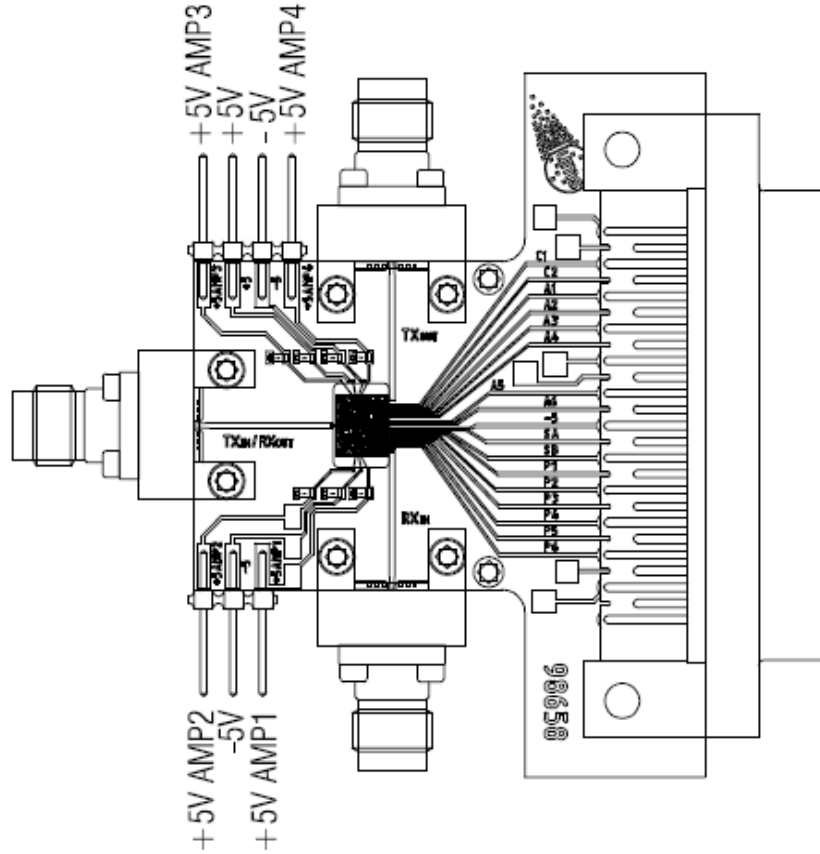
Chip thickness = 100μm +/- 10μm.

RF pads (1, 6, 24) = 122 x 200μm<sup>2</sup>

DC and control pads (2, 3, 4, 5, 7 to 23, 25, 26, 27) = 120 x 100μm<sup>2</sup>

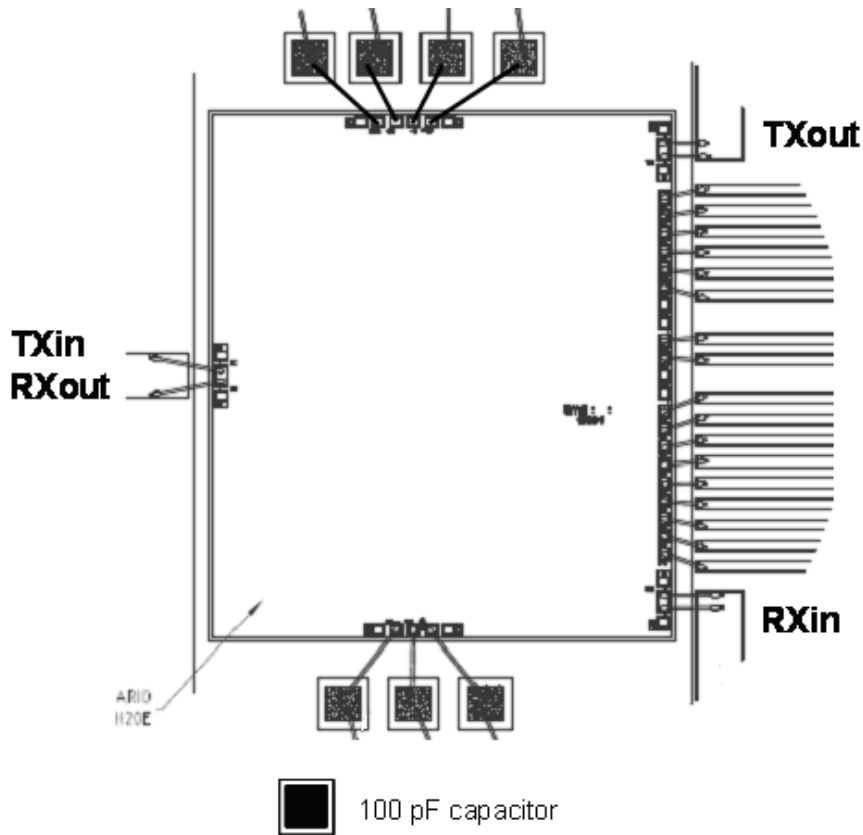
| Pin number | Pad name | Description                    | Pin number | Pad name | Description                   |
|------------|----------|--------------------------------|------------|----------|-------------------------------|
| 1          | IO       | Input/Output RF: RXout. TXin   | 15         | -5       | -5V supply voltage: interface |
| 2          | +5R      | +5V supply voltage Amp. 3      | 16         | SA       | Switch bit 1                  |
| 3          | +5       | +5V supply voltage : interface | 17         | SB       | Switch bit 2                  |
| 4          | -5       | -5V supply voltage             | 18         | P1       | Phase shifter bit 1           |
| 5          | +5T      | +5V supply voltage Amp. 4      | 19         | P2       | Phase shifter bit 2           |
| 6          | TX       | Output RF: TXout               | 20         | P3       | Phase shifter bit 3           |
| 7          | C1       | Coarse attenuator bit 1        | 21         | P4       | Phase shifter bit 4           |
| 8          | C2       | Coarse attenuator bit 2        | 22         | P5       | Phase shifter bit 5           |
| 9          | A1       | Attenuator bit 1               | 23         | P6       | Phase shifter bit 6           |
| 10         | A2       | Attenuator bit 2               | 24         | Rx       | Input RF: RXin                |
| 11         | A3       | Attenuator bit 3               | 25         | +5R      | +5V supply voltage Amp. 1     |
| 12         | A4       | Attenuator bit 4               | 26         | -5       | -5V supply voltage            |
| 13         | A5       | Attenuator bit 5               | 27         | +5       | +5V supply voltage Amp. 2     |
| 14         | A6       | Attenuator bit 6               |            |          |                               |

**Evaluation Mother board 98658**



| SUB-D Pin out: |        |        |        |        |
|----------------|--------|--------|--------|--------|
| 1- Gnd         | 6- SB  | 11- A1 | 16- P5 | 21- Nc |
| 2- Nc          | 7- -5V | 12- C1 | 17- P3 | 22- A4 |
| 3- P6          | 8- A5  | 13- Nc | 18- P1 | 23- A2 |
| 4- P4          | 9- Nc  | 14- Nc | 19- SA | 24- C2 |
| 5- P2          | 10- A3 | 15- Nc | 20- A6 | 25- Nc |

## Recommended assembly plan



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

## Bonding length recommendations

| Pad name    | Description           | Connection  |
|-------------|-----------------------|---|
| IO (Pad 1)  | TXin/Rxout            | Inductance (Lbonding) = 0.3nH<br>Two wires: diameter 25µm, length 0.470µm |
| TX (Pad 6)  | Txout                 |   |
| RX (Pad 24) | RXin                  |   |
| All others  | DC and Interface pads | Inductance (Lbonding) = 0.8nH<br>One wire: diameter 25µm, length 1mm      |

## Operating mode

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       |

## Switch control table

Voltage 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   |

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

## Attenuator control table

Voltage to apply on the pads A1 to A6:

| state | Att (dB) | A6  | A5  | A4  | A3  | A2  | A1  | state | Att (dB) | A6  | A5  | A4  | A3  | A2  | A1  |
|-------|----------|-----|-----|-----|-----|-----|-----|-------|----------|-----|-----|-----|-----|-----|-----|
| 0     | 0        | 0   | 0   | 0   | 0   | 0   | 0   | 33    | 18.15    | 3.3 | 0   | 0   | 0   | 0   | 3.3 |
| 1     | 0.55     | 0   | 0   | 0   | 0   | 0   | 3.3 | 34    | 18.7     | 3.3 | 0   | 0   | 0   | 3.3 | 0   |
| 2     | 1.1      | 0   | 0   | 0   | 0   | 3.3 | 0   | 35    | 19.25    | 3.3 | 0   | 0   | 0   | 3.3 | 3.3 |
| 3     | 1.65     | 0   | 0   | 0   | 0   | 3.3 | 3.3 | 36    | 19.8     | 3.3 | 0   | 0   | 3.3 | 0   | 0   |
| 4     | 2.2      | 0   | 0   | 0   | 3.3 | 0   | 0   | 37    | 20.35    | 3.3 | 0   | 0   | 3.3 | 0   | 3.3 |
| 5     | 2.75     | 0   | 0   | 0   | 3.3 | 0   | 3.3 | 38    | 20.9     | 3.3 | 0   | 0   | 3.3 | 3.3 | 0   |
| 6     | 3.3      | 0   | 0   | 0   | 3.3 | 3.3 | 0   | 39    | 21.45    | 3.3 | 0   | 0   | 3.3 | 3.3 | 3.3 |
| 7     | 3.85     | 0   | 0   | 0   | 3.3 | 3.3 | 3.3 | 40    | 22       | 3.3 | 0   | 3.3 | 0   | 0   | 0   |
| 8     | 4.4      | 0   | 0   | 3.3 | 0   | 0   | 0   | 41    | 22.55    | 3.3 | 0   | 3.3 | 0   | 0   | 3.3 |
| 9     | 4.95     | 0   | 0   | 3.3 | 0   | 0   | 3.3 | 42    | 23.1     | 3.3 | 0   | 3.3 | 0   | 3.3 | 0   |
| 10    | 5.5      | 0   | 0   | 3.3 | 0   | 3.3 | 0   | 43    | 23.65    | 3.3 | 0   | 3.3 | 0   | 3.3 | 3.3 |
| 11    | 6.05     | 0   | 0   | 3.3 | 0   | 3.3 | 3.3 | 44    | 24.2     | 3.3 | 0   | 3.3 | 3.3 | 0   | 0   |
| 12    | 6.6      | 0   | 0   | 3.3 | 3.3 | 0   | 0   | 45    | 24.75    | 3.3 | 0   | 3.3 | 3.3 | 0   | 3.3 |
| 13    | 7.15     | 0   | 0   | 3.3 | 3.3 | 0   | 3.3 | 46    | 25.3     | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 0   |
| 14    | 7.7      | 0   | 0   | 3.3 | 3.3 | 3.3 | 0   | 47    | 25.85    | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 3.3 |
| 15    | 8.25     | 0   | 0   | 3.3 | 3.3 | 3.3 | 3.3 | 48    | 26.4     | 3.3 | 3.3 | 0   | 0   | 0   | 0   |
| 16    | 8.8      | 0   | 3.3 | 0   | 0   | 0   | 0   | 49    | 26.95    | 3.3 | 3.3 | 0   | 0   | 0   | 3.3 |
| 17    | 9.35     | 0   | 3.3 | 0   | 0   | 0   | 3.3 | 50    | 27.5     | 3.3 | 3.3 | 0   | 0   | 3.3 | 0   |
| 18    | 9.9      | 0   | 3.3 | 0   | 0   | 3.3 | 0   | 51    | 28.05    | 3.3 | 3.3 | 0   | 0   | 3.3 | 3.3 |
| 19    | 10.45    | 0   | 3.3 | 0   | 0   | 3.3 | 3.3 | 52    | 28.6     | 3.3 | 3.3 | 0   | 3.3 | 0   | 0   |
| 20    | 11       | 0   | 3.3 | 0   | 3.3 | 0   | 0   | 53    | 29.15    | 3.3 | 3.3 | 0   | 3.3 | 0   | 3.3 |
| 21    | 11.55    | 0   | 3.3 | 0   | 3.3 | 0   | 3.3 | 54    | 29.7     | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 0   |
| 22    | 12.1     | 0   | 3.3 | 0   | 3.3 | 3.3 | 0   | 55    | 30.25    | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 3.3 |
| 23    | 12.65    | 0   | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 56    | 30.8     | 3.3 | 3.3 | 3.3 | 0   | 0   | 0   |
| 24    | 13.2     | 0   | 3.3 | 3.3 | 0   | 0   | 0   | 57    | 31.35    | 3.3 | 3.3 | 3.3 | 0   | 0   | 3.3 |
| 25    | 13.75    | 0   | 3.3 | 3.3 | 0   | 0   | 3.3 | 58    | 31.9     | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 0   |
| 26    | 14.3     | 0   | 3.3 | 3.3 | 0   | 3.3 | 0   | 59    | 32.45    | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 3.3 |
| 27    | 14.85    | 0   | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 60    | 33       | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 0   |
| 28    | 15.4     | 0   | 3.3 | 3.3 | 3.3 | 0   | 0   | 61    | 33.55    | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 3.3 |
| 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   |       |          |     |     |     |     |     |     |

Fine attenuator control table

## Phase shifter control table

Voltage to apply on the pads P1 to P6:

| state | Phase (deg) | P6  | P5  | P4  | P3  | P2  | P1  | state | Phase (deg) | P6  | P5  | P4  | P3  | P2  | P1  |
|-------|-------------|-----|-----|-----|-----|-----|-----|-------|-------------|-----|-----|-----|-----|-----|-----|
| 0     | 0           | 0   | 0   | 0   | 0   | 0   | 0   | 33    | -185.625    | 3.3 | 0   | 0   | 0   | 0   | 3.3 |
| 1     | -5.625      | 0   | 0   | 0   | 0   | 0   | 3.3 | 34    | -191.25     | 3.3 | 0   | 0   | 0   | 3.3 | 0   |
| 2     | -11.25      | 0   | 0   | 0   | 0   | 3.3 | 0   | 35    | -196.875    | 3.3 | 0   | 0   | 0   | 3.3 | 3.3 |
| 3     | -16.875     | 0   | 0   | 0   | 0   | 3.3 | 3.3 | 36    | -202.5      | 3.3 | 0   | 0   | 3.3 | 0   | 0   |
| 4     | -22.5       | 0   | 0   | 0   | 3.3 | 0   | 0   | 37    | -208.125    | 3.3 | 0   | 0   | 3.3 | 0   | 3.3 |
| 5     | -28.125     | 0   | 0   | 0   | 3.3 | 0   | 3.3 | 38    | -213.75     | 3.3 | 0   | 0   | 3.3 | 3.3 | 0   |
| 6     | -33.75      | 0   | 0   | 0   | 3.3 | 3.3 | 0   | 39    | -219.375    | 3.3 | 0   | 0   | 3.3 | 3.3 | 3.3 |
| 7     | -39.375     | 0   | 0   | 0   | 3.3 | 3.3 | 3.3 | 40    | -225        | 3.3 | 0   | 3.3 | 0   | 0   | 0   |
| 8     | -45         | 0   | 0   | 3.3 | 0   | 0   | 0   | 41    | -230.625    | 3.3 | 0   | 3.3 | 0   | 0   | 3.3 |
| 9     | -50.625     | 0   | 0   | 3.3 | 0   | 0   | 3.3 | 42    | -236.25     | 3.3 | 0   | 3.3 | 0   | 3.3 | 0   |
| 10    | -56.25      | 0   | 0   | 3.3 | 0   | 3.3 | 0   | 43    | -241.875    | 3.3 | 0   | 3.3 | 0   | 3.3 | 3.3 |
| 11    | -61.875     | 0   | 0   | 3.3 | 0   | 3.3 | 3.3 | 44    | -247.5      | 3.3 | 0   | 3.3 | 3.3 | 0   | 0   |
| 12    | -67.5       | 0   | 0   | 3.3 | 3.3 | 0   | 0   | 45    | -253.125    | 3.3 | 0   | 3.3 | 3.3 | 0   | 3.3 |
| 13    | -73.125     | 0   | 0   | 3.3 | 3.3 | 0   | 3.3 | 46    | -258.75     | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 0   |
| 14    | -78.75      | 0   | 0   | 3.3 | 3.3 | 3.3 | 0   | 47    | -264.375    | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 3.3 |
| 15    | -84.375     | 0   | 0   | 3.3 | 3.3 | 3.3 | 3.3 | 48    | -270        | 3.3 | 3.3 | 0   | 0   | 0   | 0   |
| 16    | -90         | 0   | 3.3 | 0   | 0   | 0   | 0   | 49    | -275.625    | 3.3 | 3.3 | 0   | 0   | 0   | 3.3 |
| 17    | -95.625     | 0   | 3.3 | 0   | 0   | 0   | 3.3 | 50    | -281.25     | 3.3 | 3.3 | 0   | 0   | 3.3 | 0   |
| 18    | -101.25     | 0   | 3.3 | 0   | 0   | 3.3 | 0   | 51    | -286.875    | 3.3 | 3.3 | 0   | 0   | 3.3 | 3.3 |
| 19    | -106.875    | 0   | 3.3 | 0   | 0   | 3.3 | 3.3 | 52    | -292.5      | 3.3 | 3.3 | 0   | 3.3 | 0   | 0   |
| 20    | -112.5      | 0   | 3.3 | 0   | 3.3 | 0   | 0   | 53    | -298.125    | 3.3 | 3.3 | 0   | 3.3 | 0   | 3.3 |
| 21    | -118.125    | 0   | 3.3 | 0   | 3.3 | 0   | 3.3 | 54    | -303.75     | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 0   |
| 22    | -123.75     | 0   | 3.3 | 0   | 3.3 | 3.3 | 0   | 55    | -309.375    | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 3.3 |
| 23    | -129.375    | 0   | 3.3 | 0   | 3.3 | 3.3 | 3.3 | 56    | -315        | 3.3 | 3.3 | 3.3 | 0   | 0   | 0   |
| 24    | -135        | 0   | 3.3 | 3.3 | 0   | 0   | 0   | 57    | -320.625    | 3.3 | 3.3 | 3.3 | 0   | 0   | 3.3 |
| 25    | -140.625    | 0   | 3.3 | 3.3 | 0   | 0   | 3.3 | 58    | -326.25     | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 0   |
| 26    | -146.25     | 0   | 3.3 | 3.3 | 0   | 3.3 | 0   | 59    | -331.875    | 3.3 | 3.3 | 3.3 | 0   | 3.3 | 3.3 |
| 27    | -151.875    | 0   | 3.3 | 3.3 | 0   | 3.3 | 3.3 | 60    | -337.5      | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 0   |
| 28    | -157.5      | 0   | 3.3 | 3.3 | 3.3 | 0   | 0   | 61    | -343.125    | 3.3 | 3.3 | 3.3 | 3.3 | 0   | 3.3 |
| 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   |       |             |     |     |     |     |     |     |

Phase shifter control table

## Recommended ESD management

Refer to the application note AN0020 available at <http://www.ums-gaas.com> for ESD sensitivity and handling recommendations for the UMS products.

## Ordering Information

Chip form: CHC3014-99F/00

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