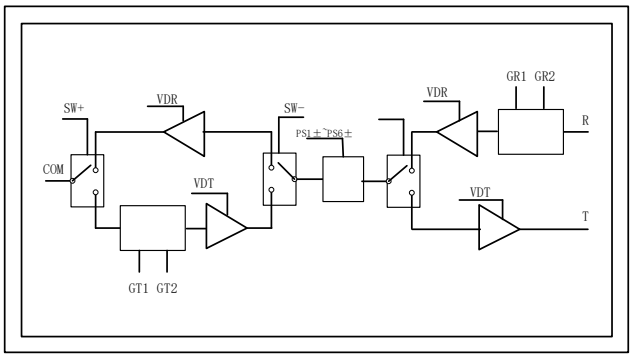
1. Description

- The M7130 is a GaAs Bi-Directional Amplifier with 6-bit Digital Phase-Shifter fabricated on GaAs p-HEMT MMIC process. It operates over 14-19.5 GHz, the OP-1dB of Rx is 13dBm with 23dB gain and 4dB noise figure, the OP-1dB of Tx is 13dBm with 15dB gain. It provides 360° of phase coverage with a LSB of 5.625°. It also achieves a low RMS phase error of 3.5° and RMS amplitude error of 0.5dB.



M7130-PDS-F01

Figure 1. M7130 Functional Block

2. Applications

- Microwave transceiver component

3. Features[1]

- Frequency Range: 14-19.5 GHz
- Tx Small Signal Gain: 15dB
- Tx S11/S22: -13dB/-15dB
- Tx Output P-1dB: 13dBm
- Tx Quiescent Current: 50mA
- Rx Small Signal Gain: 23dB
- Rx S11/S22: -13dB/-15dB
- Rx Noise Figure: 4dB
- Rx Output P-1dB: 13dBm
- Rx Quiescent Current: 50mA
- 6-Bit Digital Phase Shifter
- 360°Coverage with a LSB of 5.625°
- RMS Phase Error: 3.5°
- RMS Amplitude Error: 0.5dB
- Die Size: 3.00 x 1.20 x 0.10mm

[1] On-wafer Test

4. Brief Typical Performance

Table 1. Brief Typical Performance

Parameter	14-19.5GHz	Units
Tx Small Signal Gain	15	dB
Tx Output P-1dB	13	dBm
Tx Quiescent Current	50	mA
Rx Small Signal Gain	23	dB
Rx Noise Figure	4	dB
Rx Output P-1dB	13	dBm
Rx Quiescent Current	50	mA
RMS Phase Error	3.5	°
RMS Amplitude Error	0.5	dB

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5. Recommended Operating Conditions

Table 2. Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Temperature Range	-55	25	85	°C
Control Voltage, SW+/ SW-	-	0/-5	-	V
Control Voltage, S1+/ S1- to S6+/ S6-		0/-5		V
R_X Supply Voltage, VDR	-	5	-	V
T_X Supply Voltage, VDT	-	5	-	V

6. RF Characteristics (T_C = 25°C)

Table 3. RF Characteristics

Parameter	Functional symbol	Min.	Typ.	Max.	Units
T_X Small Signal Gain	$S21_T_X$	-	15	-	dB
T_X S11	$S11_T_X$	-	-13	-	dB
T_X S22	$S22_T_X$	-	-15	-	dB
T_X Output P_{-1dB}	$OP_{-1dB}_R_X$	-	13	-	dBm
T_X Quiescent Current	$I_{DQ}_T_X$	-	50	-	mA
R_X Small Signal Gain	$S21_R_X$	-	23	-	dB
R_X S11	$S11_R_X$	-	-13	-	dB
R_X S22	$S22_R_X$	-	-15	-	dB
R_X Output P_{-1dB}	$OP_{-1dB}_R_X$	-	13	-	dBm
R_X Noise Figure	NF	-	4	-	dB
R_X Quiescent Current	$I_{DQ}_R_X$	-	50	-	mA
RMS Phase Error	RMS (°)	-	3.5	-	°
RMS Amplitude Error	ΔIL	-	0.5	-	dB
Supply Current of Logic Circuit	I_{ss}	-	5	-	mA

7. Typical Performance Curve

■ Small-signal characteristics

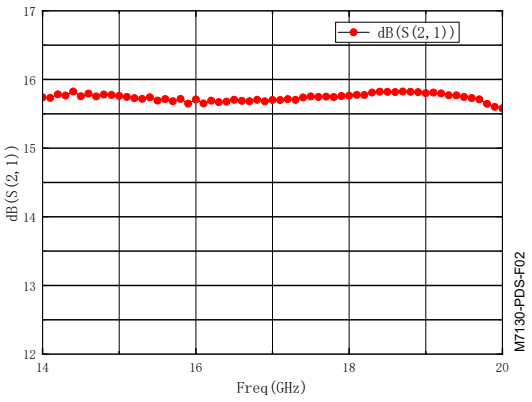


Figure 2. T_X Small-Signal Gain Characteristics

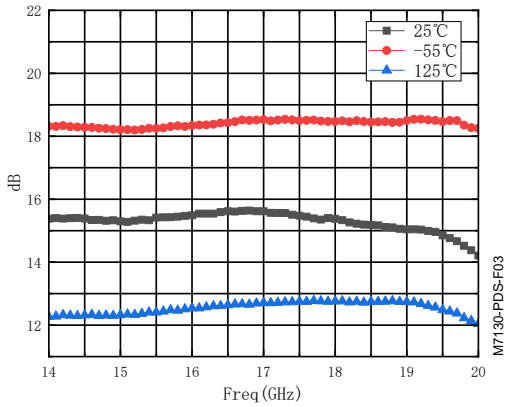


Figure 3. T_X Small-Signal Gain Characteristics

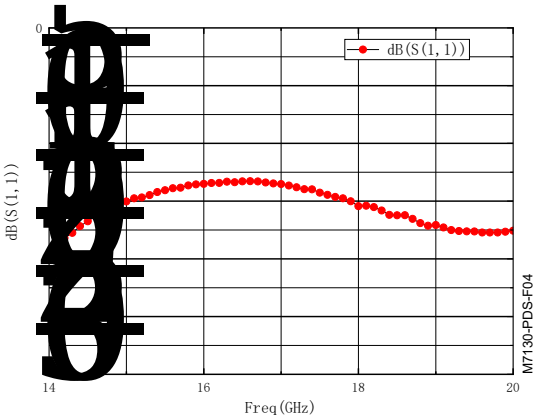


Figure 4. T_X Small-Signal S11 Characteristics

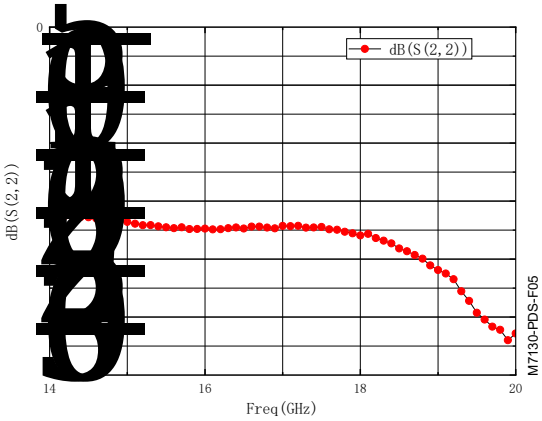


Figure 5. T_X Small-Signal S22 Characteristics

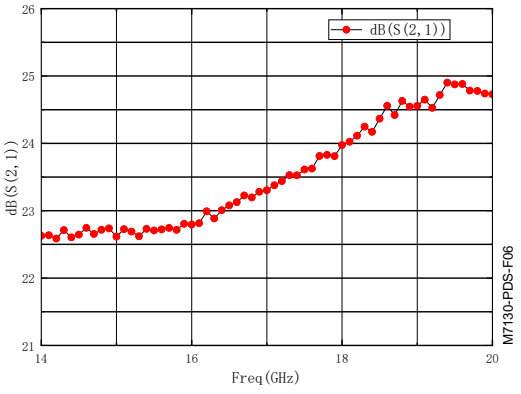


Figure 6. R_X Small-Signal Gain Characteristics

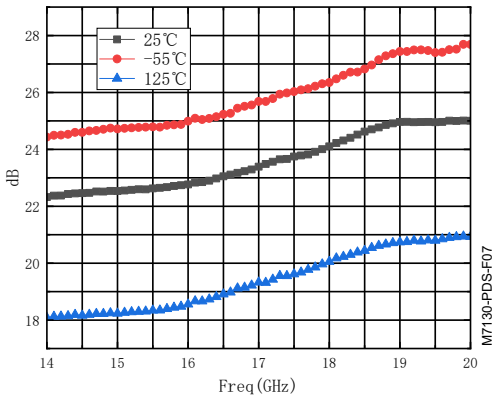


Figure 7. R_X Small-Signal Gain Characteristics

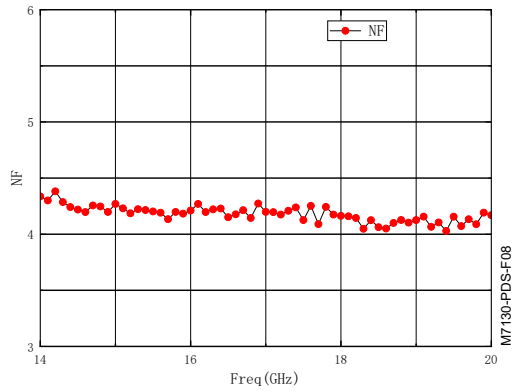


Figure 8. Rx Noise Figure Characteristics

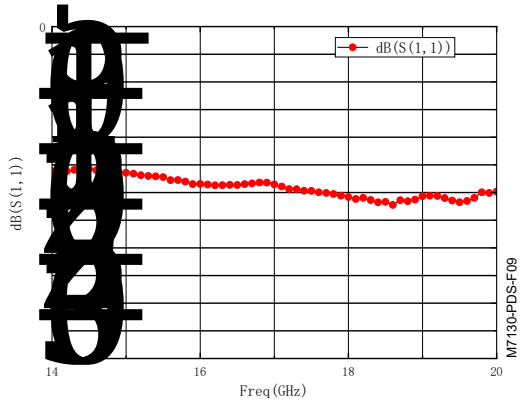


Figure 9. Rx Small-Signal S11 Characteristics

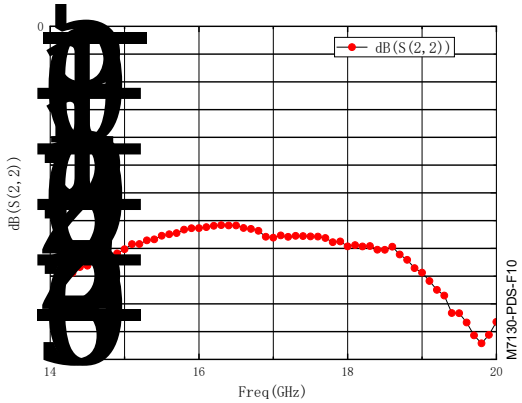


Figure 10. Rx Small-Signal S22 Characteristics

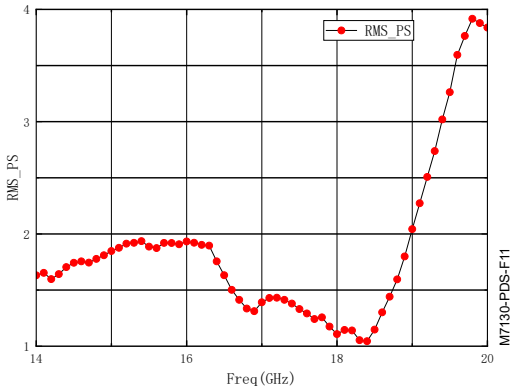


Figure 11. RMS Phase Error Characteristics

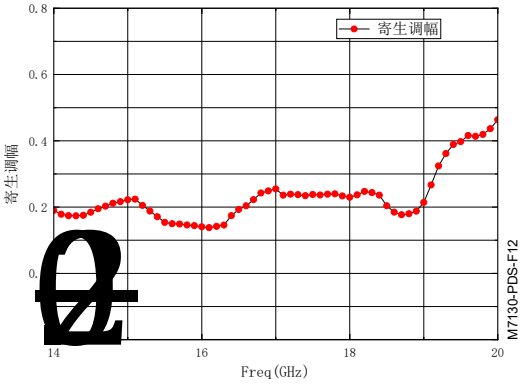


Figure 12. RMS Amplitude Error Characteristics

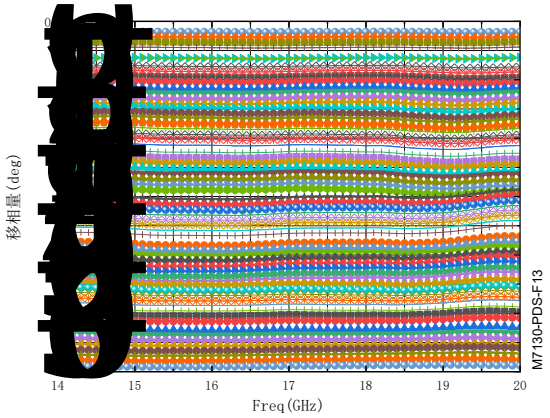


Figure 13. Full State Phase Shift Characteristics

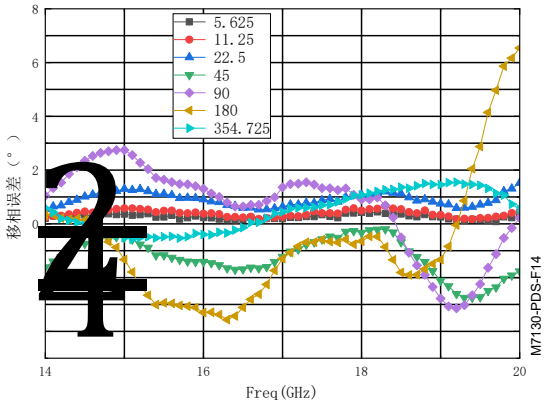


Figure 14. Phase Error of Basic Phase Shift State

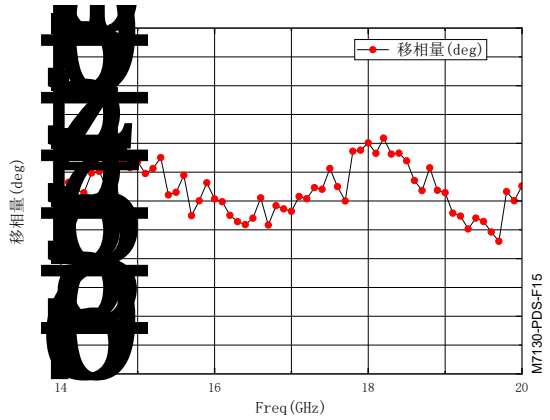


Figure 15. 5.625°Phase-shift Characteristics

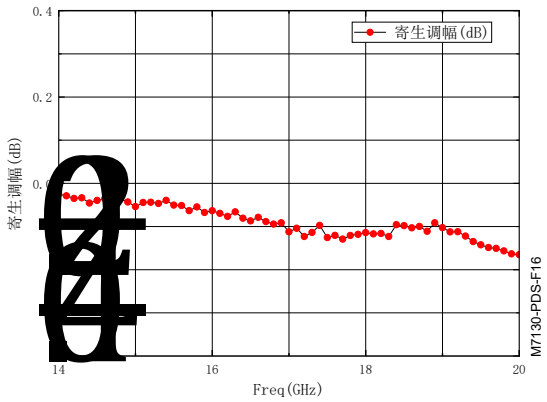


Figure 16. 5.625°Amplitude Error Characteristics

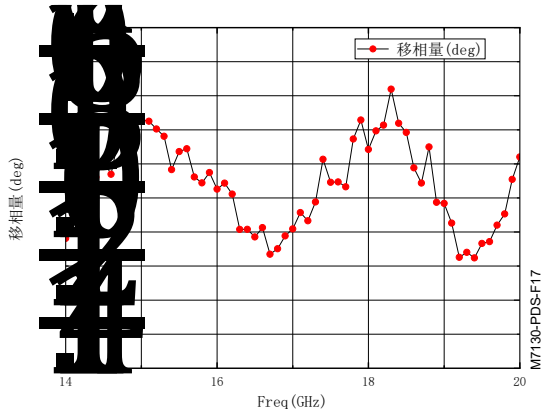


Figure 17. 11.25°Phase-shift Characteristics

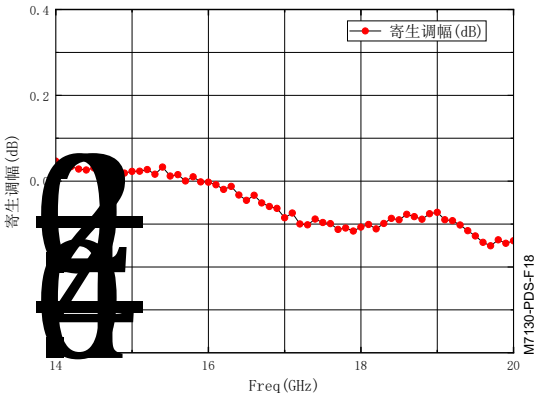


Figure 18. 11.25°Amplitude Error Characteristics

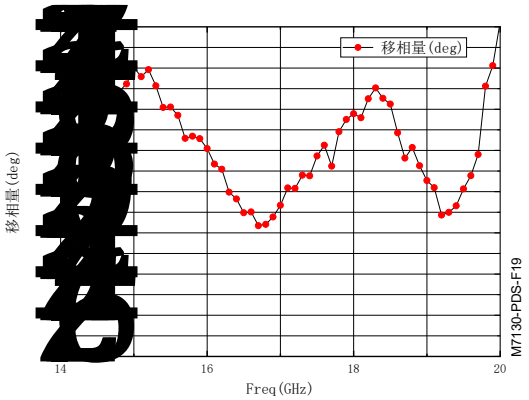


Figure 19. 22.5°Phase-shift Characteristics

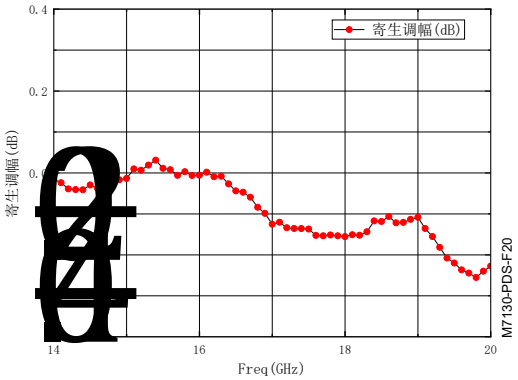


Figure 20. 22.5°Amplitude Error Characteristics

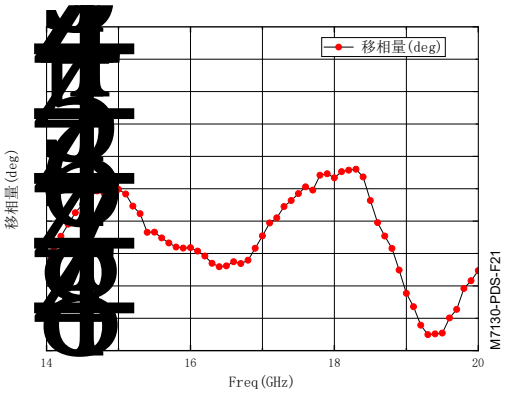


Figure 21. 45°Phase-shift Characteristics

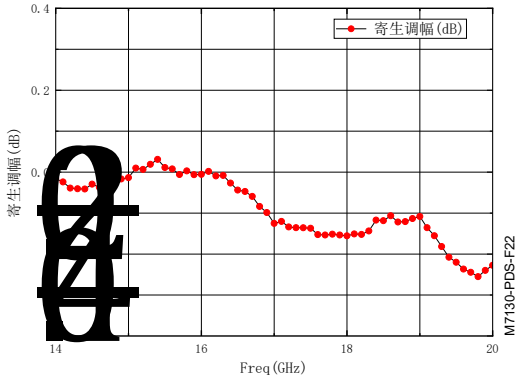


Figure 22. 45°Amplitude Error Characteristics

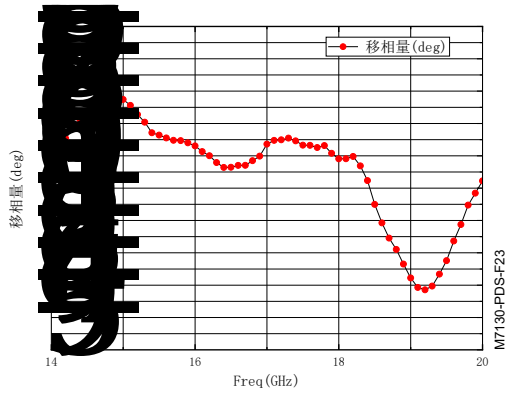


Figure 23. 90°Phase-shift Characteristics

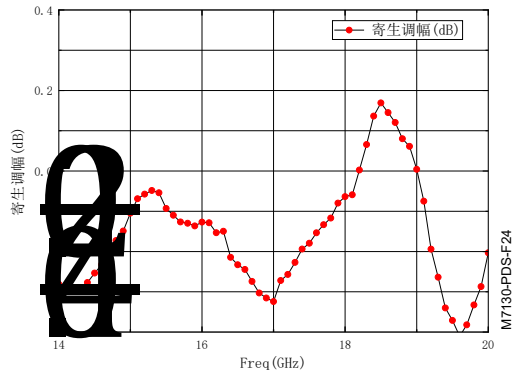


Figure 24. 90°Amplitude Error Characteristics

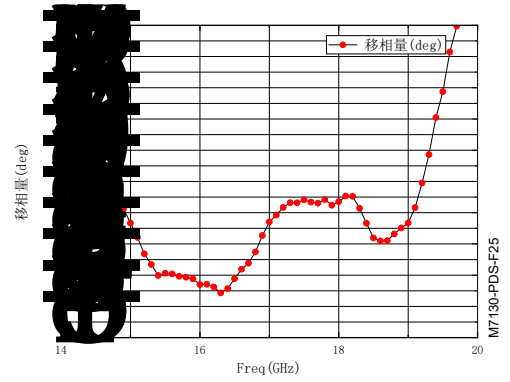


Figure 25. 180°Phase-shift Characteristics

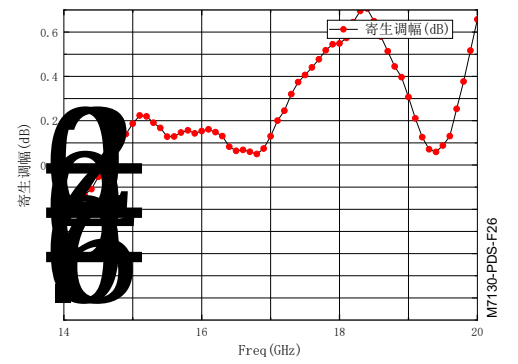


Figure 26. 180°Amplitude Error Characteristics

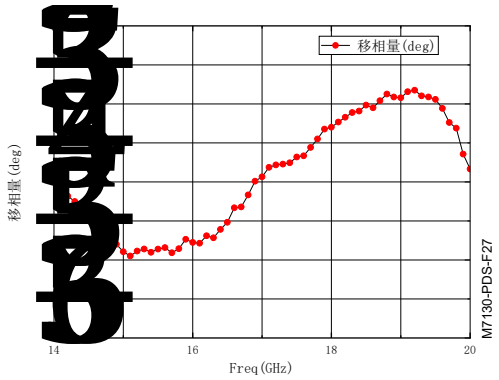


Figure 27. 354.375°Phase-shift Characteristics

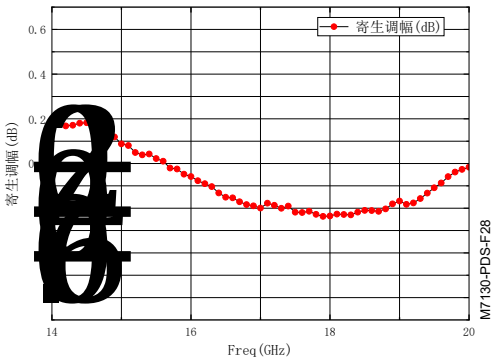


Figure 28. 354.375°Amplitude Error Characteristics

■ Power Characteristic Curve

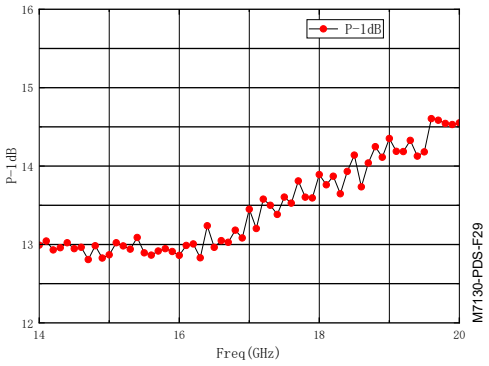


Figure 29. T_X OP_{-1dB} Characteristics

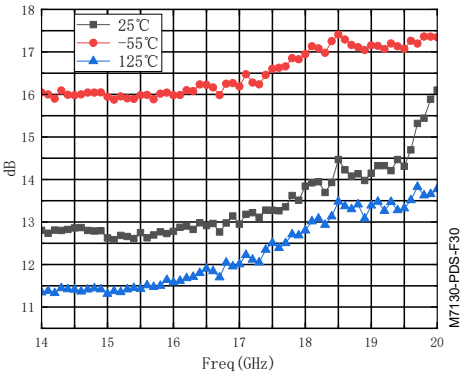


Figure 30. T_X OP_{-1dB} Characteristics

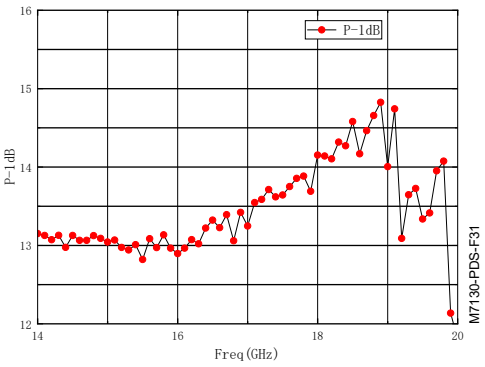


Figure 31. R_X OP_{-1dB} Characteristics

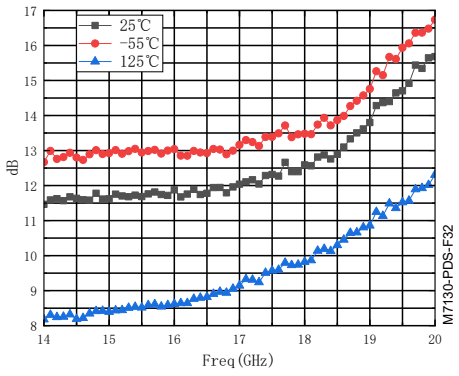
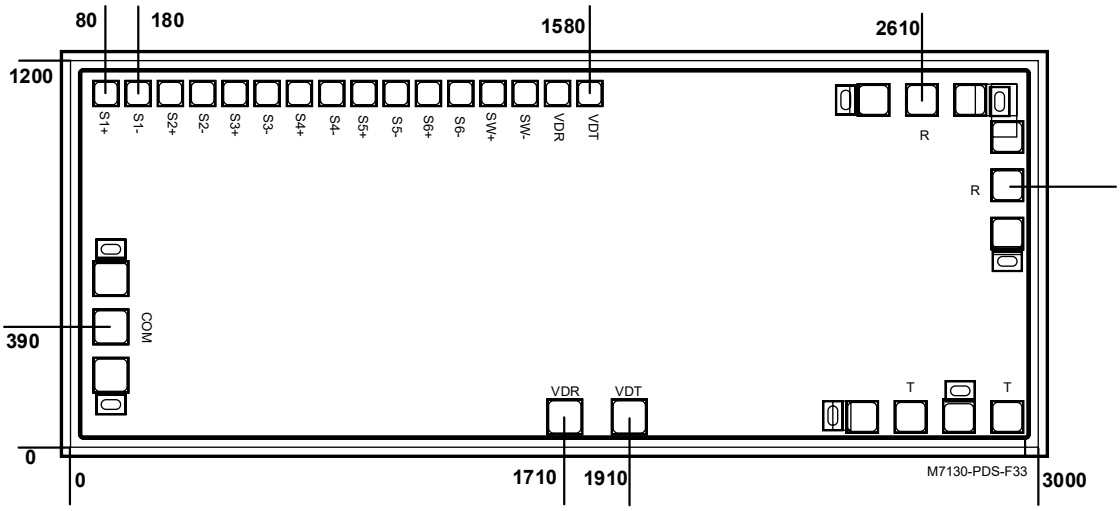


Figure 32. R_X OP_{-1dB} Characteristics

8. Outline Dimensions



- Dimensions shown in micrometre

Figure 33. M7130 Outline Dimensions

Table 4. Pad Description

Pad	Description	Note
1	COM	T_X Input / R_X Output
2	R	R_X Input (Arbitrary pad can be selected)
3	T	T_X Output (Arbitrary pad can be selected)
4	VDT	T_X Supply Voltage (Arbitrary pad can be selected)
5	VDR	R_X Supply Voltage (Arbitrary pad can be selected)
6	SW+	T_X / R_X / Load Control Voltage
7	SW-	T_X / R_X / Load Control Voltage
8	S1+	90° Phase Shift Control Voltage
9	S1-	90° Phase Shift Control Voltage
10	S2+	22.5° Phase Shift Control Voltage
11	S2-	22.5° Phase Shift Control Voltage
12	S3+	11.25° Phase Shift Control Voltage
13	S3-	11.25° Phase Shift Control Voltage
14	S4+	5.625° Phase Shift Control Voltage
15	S4-	5.625° Phase Shift Control Voltage
16	S5+	45° Phase Shift Control Voltage
17	S5-	45° Phase Shift Control Voltage
18	S6+	180° Phase Shift Control Voltage
19	S6-	180° Phase Shift Control Voltage

Table 5. Truth Table

5-1：Tx/Rx Control Truth Table

	VDT	VDR	SW+	SW-
Tx	+5V	0V	0V	-5V
Rx	0V	+5V	-5V	0V
Load	0V	0V	0V	-5V
Load	0V	0V	-5V	0V

5-2：Phase-Shift Truth Table

S6-	S6+	S5-	S5+	S4-	S4+	S3-	S3+	S2-	S2+	S1-	S1+	Phase Shift State
0	-5V	0	-5V	0	-5V	0	-5V	0	-5V	0	-5V	0°
0	-5V	0	-5V	-5V	0	0	-5V	0	-5V	0	-5V	5.625°
0	-5V	0	-5V	0	-5V	-5V	0	0	-5V	0	-5V	11.25°
0	-5V	0	-5V	0	-5V	0	-5V	-5V	0	0	-5V	22.5°
0	-5V	-5V	0	0	-5V	0	-5V	0	-5V	0	-5V	45°
0	-5V	0	-5V	0	-5V	0	-5V	0	-5V	-5V	0	90°
-5V	0	0	-5V	0	-5V	0	-5V	0	-5V	0	-5V	180°
-5V	0	-5V	0	-5V	0	-5V	0	-5V	0	-5V	0	354.375°

9. Assembly Information

■ Assembly Diagram

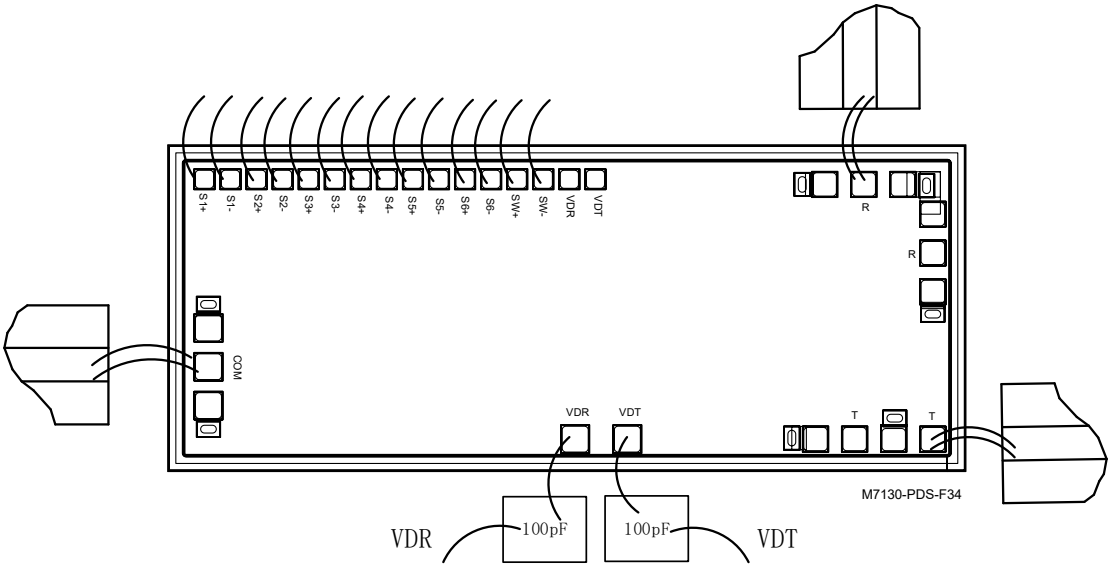


Figure 34. M7130 Assembly Diagram

- **Eutectic Die Attach:** It is best to use an 80% Au/20% Sn preform. Do not expose the chip to a temperature greater than 300°C for more than 30sec.
- **Wire Bonding:** RF bonds made with 1mil gold wire are recommended for the RF ports. Keep all bonds as short as possible, less than 0.35mm.

10. Handling Precautions

- **Storage**

  All bare dies ship in either Waffle or Gel Pak, which is an ESD protective container, and then sealed in an ESD protective bag. After opening the sealed ESD protective bag, all dies must be stored in a dry nitrogen environment.

- **Cleanliness**

  Handle the dies in a clean environment. Never use liquid cleaning systems to clean the dies.

- **ESD Caution**

  ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore proper ESD precautions should be taken to avoid performance degradation or loss of functionality.



11. Contact Information

For the latest specifications, additional product information, technical support and sales support, please contact:

- **Email:** RF.support@raytrontek.com
- **Web:** www.raytrontek.com

12. Disclaimer

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