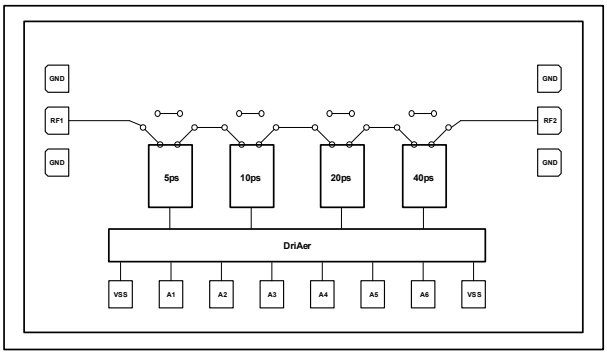
1. Description

- The M0060 is a wideband, 4-bit Digital Controlled True-Time Delay operating from 2 to 6GHz, which is fabricated using GaAs MMIC process. It provides true time delay (TTD) functionality with a precise minimum step of 5ps. The device maintains an insertion loss of -4.5dB and achieves return loss better than -15dB, making it an ideal solution for advanced RF and microwave systems requiring precise time control.



M0060-PDS-F01

Figure 1. M0060 Functional Block Diagram

2. Applications

- TX/RX Modules
- Radar
- Defense

3. Features

- Frequency Range: 2 - 6GHz
- Insertion Loss: 4.5dB
- Insertion Loss Flatness: ±0.5dB
- Input/Output Return Loss: -15dB
- Time Delay Step: 5ps
- Time Delay Range: 0 - 150ps
- Time Delay Error: ±1.5ps
- Amplitude Error RMS: 0.5dB
- Control Voltage: 0/+5V
- Die Size: 2.2 x 1.3 x 0.1mm

[1] On-wafer Test

4. Brief Typical Performance

Table 1. Brief Typical Performance

Parameter	2-6 GHz	Units
Insertion Loss	4.5	dB
Insertion Loss Flatness	±0.5	dB
Input/Output Return Loss	-15	dB
Time Delay Step	5	ps
Time Delay Range	0-150	ps
Time Delay Error	±1.5	ps
Amplitude Error RMS	0.5	dB
Input P_{-1dB}	29	dBm

Table of Contents

No.	Contents	Page
1	Description	1
2	Applications	1
3	Features	1
4	Brief Typical Performance	1
5	Recommended Operating Conditions	3
6	RF Characteristics	3
7	Typical Performance Curve	3
8	Outline Dimensions	5
9	Assembly Information	6
10	Handling Precautions	6
11	Contact Information	7
12	Disclaimer	7

5. Recommended Operating Conditions

Table 2. Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Temperature Range	-55	25	125	°C
Control Voltage, V1-V6	-	0/5	-	V
Reference Voltage, VSS	-	-5	-	V

6. RF Characteristics (T_C = 25˚C)

Table 3. RF Characteristics[1]

Parameter	Symbol	Min.	Typ.	Max.	Units
Insertion Loss	IL	3.6	4.5	5.2	dB
Input Return Loss	RL_{IN}	-	-20	-16	dB
Output Return Loss	RL_{OUT}	-	-20	-15.7	dB
Time Delay Error	Error	-	±1.5	-	ps
Amplitude Error RMS	ΔIL	-	0.5	-	dB
Phase Error	Phase Error	-	±4	-	°

[1]. Test condition: Input signal CW

7. Typical Performance Curve

■ Small-signal Characteristics Curve

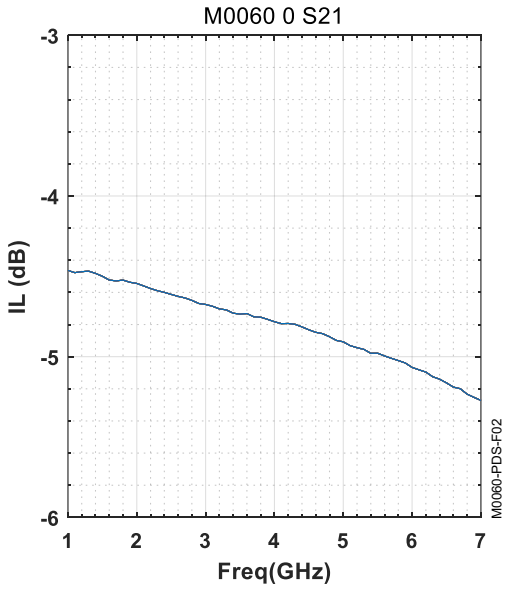


Figure 2. Reference State Insertion Loss Characteristics

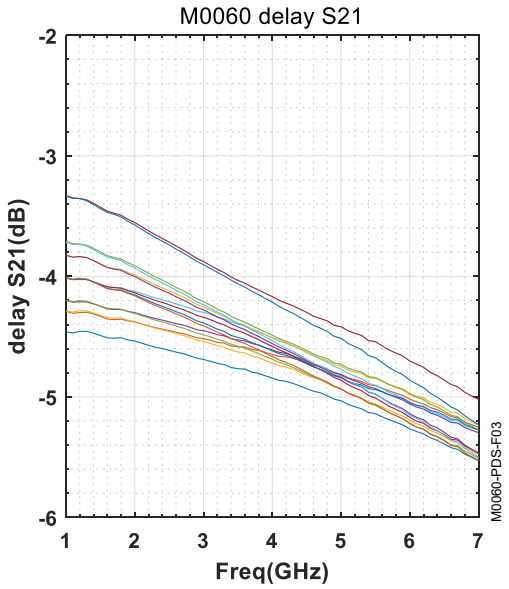


Figure 3. Full State Insertion Loss Characteristics

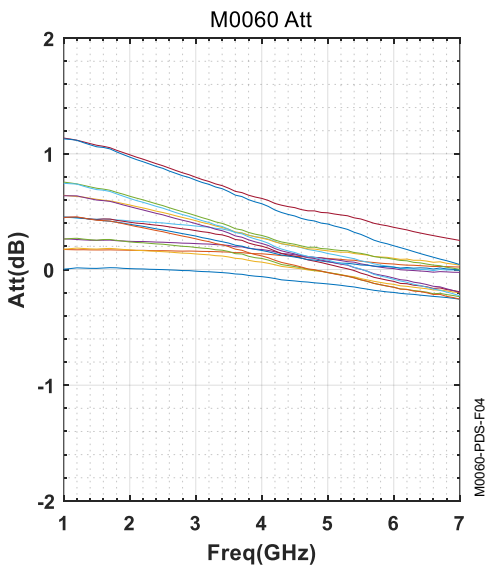


Figure 4. Full State Amplitude Error Characteristics

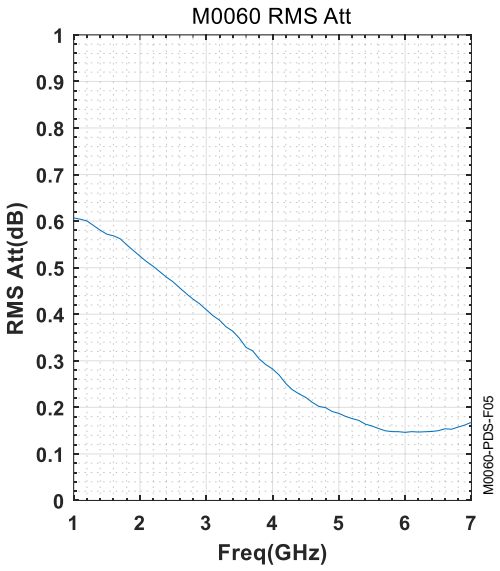


Figure 5. Amplitude Error RMS Characteristics

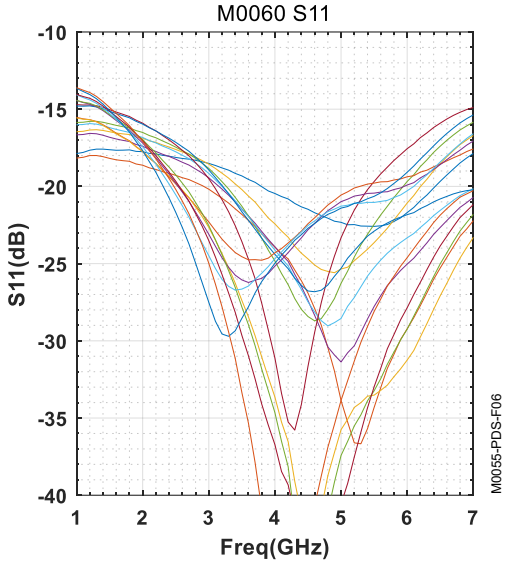


Figure 6. Full State lutput Return Loss Characteristics

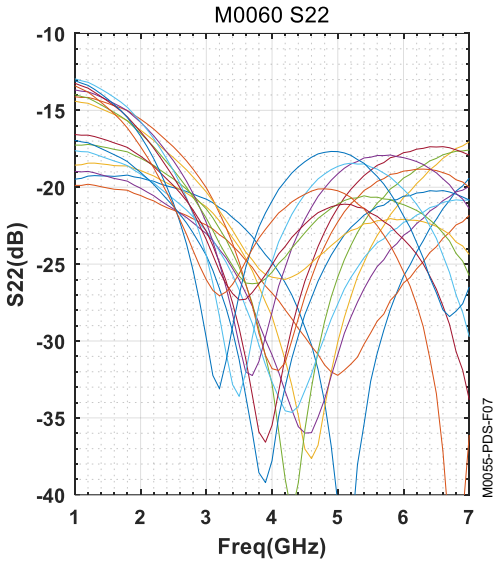


Figure 7. Full State Output Return Loss Characteristics

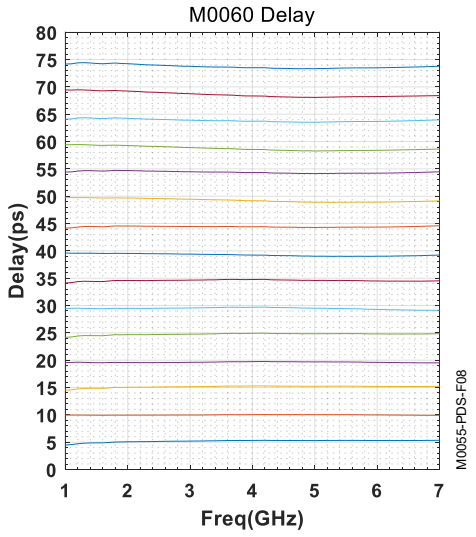


Figure 8. Full State Time Delay Characteristics

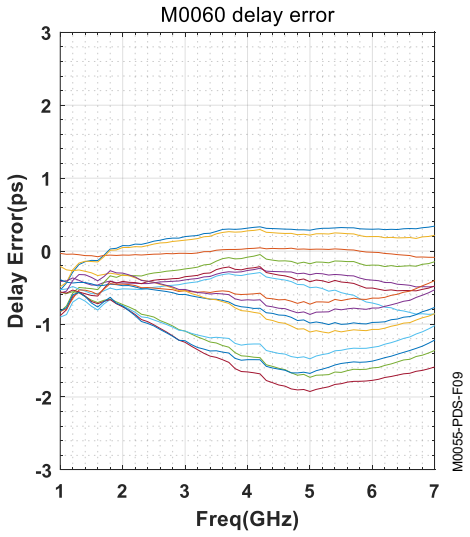
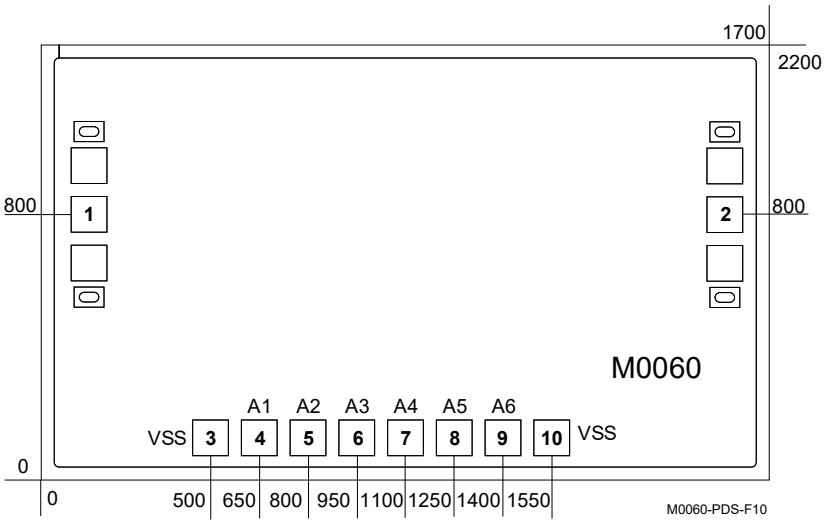


Figure 9. Full State Time Delay Error Characteristics

8. Outline Dimensions



- Dimensions shown in micrometre

Figure 10. M0060 Outline Dimensions

Table 4. Pad Description

Pad	Symbol	Description
1	RF1	RF Input
2	RF2	RF Output
6-9	A3-A6	Control Voltage
4/5	A1/A2	N/C
3/10	VSS	Reference Voltage

Table 5. Truth Table (Logic "0" = 0V, Logic"1" = +5V)

	A3	A4	A5	A6	VSS
0(Reference)	0	0	0	0	-5
5ps	1	0	0	0	-5
10ps	0	1	0	0	-5
20ps	0	0	1	0	-5
40ps	0	0	0	1	-5
75ps	1	1	1	1	-5

9. Assembly Information

■ Assembly Diagram

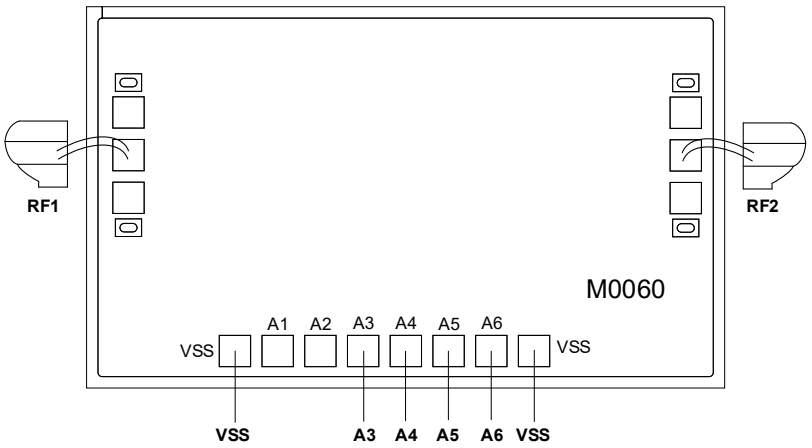


Figure 11. M0060 Assembly Diagram

- **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.

M0060-PDS-F11

■ 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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