77 GHz MPA for Car Radar Systems T626_MPA2_W

Preliminary Data Sheet

- Operating Frequency: 76 - 77 GHz
- Output Power: + 13 dBm
- Input and Output matched to 50 Ω
- Application in Car Radar Systems

ESD: **E**lectro**s**tatic **d**ischarge sensitive device, observe handling precautions!

Type	Marking	Ordering Code	Package
T626_MPA2_W	–	Q62702-G173	Chip

The T626_MPA2_W is a millimeter wave, medium power amplifier, suitable for signal amplification in modern, MMIC-based car radar systems. It might be used as small signal amplifier or as output stage.

The MMIC will be delivered with wirebond compatible pads. To ease substrate design, the MMIC's layout can be provided in dxf- or gds2-format.

Circuit Description

The T626_MPA2_W incorporates a two-stage, PHEMT - based millimeter wave amplifier. Both input and output are matched to 50 Ω.

The T626_MPA2_W is optimized for mounting on a metal plate, different performance might be expected using flip-chip mounting.

The MPA delivers at least 13 dBm of RF output power with 3 dB compression. The small-signal gain is 8 dB.

Over a temperature range of T_{amb} = – 40 to + 95 °C, the output power variation is less than 3 dB without DC bias compensation.

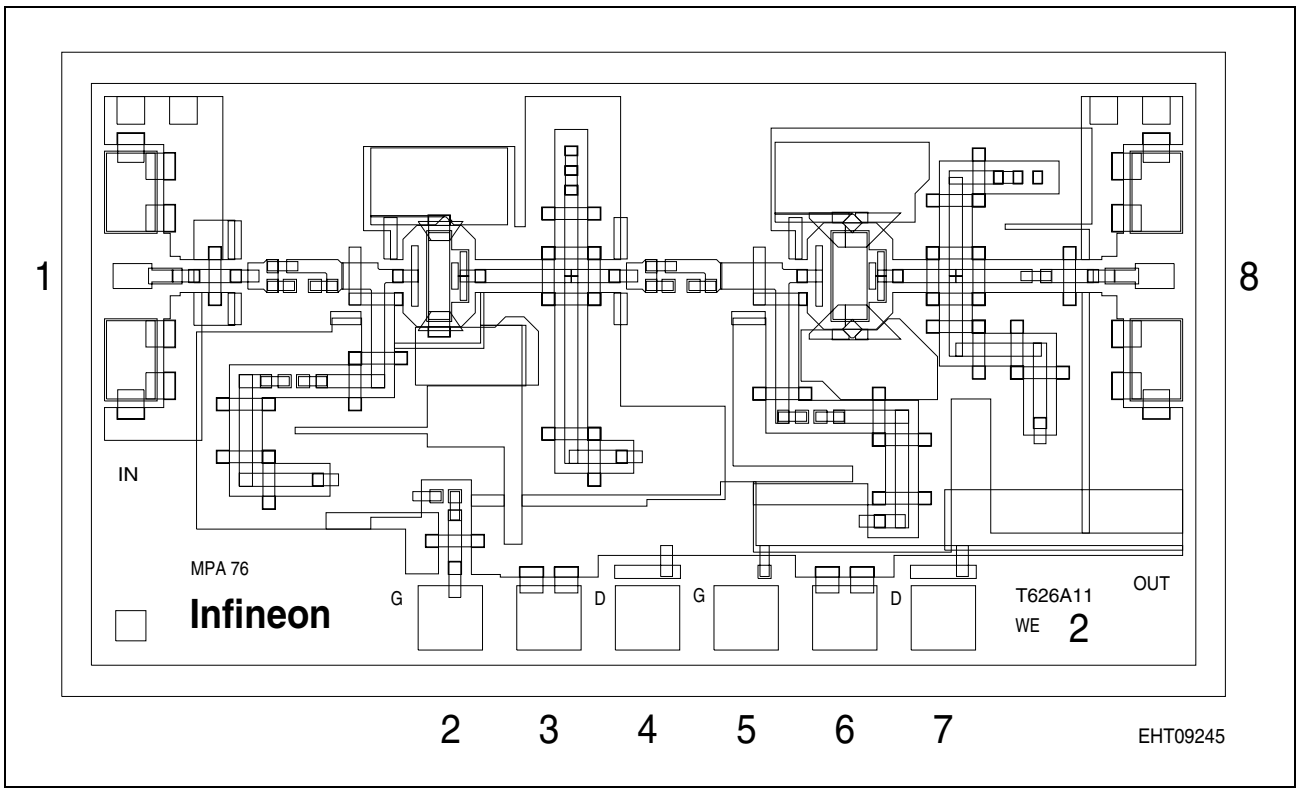

Figure 1 Pin Configuration

Pin Configuration

Pad	Symbol	Function
1	RF IN	Coplanar RF Input, Matched to 50 Ω Typically 46 µm RF Signal Pad Width, 37 µm Gap to GND Pads RF Probing: Use 100 to 120 µm Ground – Signal – Ground Pitch
2	V_{G1}	Gate Voltage 1st PHEMT Amplifier Stage
3	GND	Chip DC Ground
4	V_{D1}	Drain Voltage 1st PHEMT Amplifier Stage
5	V_{G2}	Gate Voltage 2nd PHEMT Amplifier Stage
6	GND	Chip DC Ground
7	V_{D2}	Drain Voltage 2nd PHEMT Amplifier Stage
8	RF OUT	Coplanar RF Output, Matched to 50 Ω Typically 46 µm RF Signal Pad Width, 37 µm Gap to GND Pads RF Probing: Use 100 to 120 µm Ground – Signal – Ground Pitch

The bias pads (2 - 7) have 150 µm pitch.

Characteristic - General and DC

Parameter	Symbol	Typ. Value	Unit
Ambient Temperature[1)]	T_{amb}	– 40 to + 105	°C
Drain Supply Voltage, 1st Stage	V_{D1}	3.4	V
Gate Supply Voltage, 1st Stage	V_{G1}	0.2	V
Drain Supply Current, 1st Stage	I_{D1}	40	mA
Drain Supply Voltage, 2nd Stage	V_{D2}	3.6	V
Gate Supply Voltage, 2nd Stage	V_{G2}	0.2	V
Drain Supply Current, 2nd Stage	I_{D2}	60	mA

1) Chip's backside mounted on a metal heatsink.

Characteristic - RF

Parameter[1)]	Symbol	Typ. Value	Unit
Operation frequency	f_0	76 to 77	GHz
RF Output Power, 1 dB compression	$P_{OUT-1dB}$	11	dBm
RF Output Power, 3 dB compression	$P_{OUT-3dB}$	13	dBm
RF Output Power, saturation	P_{SAT}	13.5	dBm
Small Signal Gain (P_{IN} = – 10 dBm)	G_S	8	dB
Large Signal Gain (P_{IN} = + 6 dBm)	G_S	6.5	dB
Isolation with both stages V_D = 0	A_i	> 30	dB

1) The given parameters assume 50 Ω RF load impedance and an ambient temperature of T_{amb} = 25 °C. The chip's backside is mounted on a metal plate. Chip thickness is 100 µm. The T626_MPA2_W is intended for wire bonding only. Flip chip mounting with stud bumps might lead to different performance.

Geometry

Parameter	Symbol	Typ. Value	Unit
Chip Thickness	d_{Chip}	100	µm
Chip Outline	A_{Chip}	1.68 × 0.89	mm^2
Bond Pad Size DC	$A_{BondpadDC}$	100 × 100	$µm^2$
Bond Pad Pitch DC	$DC\ Pitch$	150	µm
Bond Pad Size RF	$A_{BondpadRF}$	50 × 50	$µm^2$
Bond Pad Pitch RF[1)]	$CPW\ Pitch$	120	µm

1) RF Probing: Use G-S-G Probes with 100 to 120 µm Pitch.

Recommended Bonding Conditions

Parameter	Thermal Compression[1)]	Wedge Bonding	Unit
Chuck Temp.	250	250	°C
Tool Temp.	180	150	°C
Scrub	100	–	Hz
Bond Force	50	25	g
Wire Diameter	25	17	µm
Bond Pull Test (1)	2.5[2)]		g
Bond Pull Test (2)	3.1[2)]		g
Bond Pull Test (3)	3.2[2)]		g
Bond Pull Test (4)	3.0[2)]		g
Bond Pull Test (5)	2.8[2)]		g

1) Nailhead, no ultrasonic
2) See Mil 883, > 2 g

Application Note: Infineon Semiconductors in Modern ACC Radar Systems

Infineon provides a variety of car radar products to simplify the design of modern, MMIC-based car radar systems:

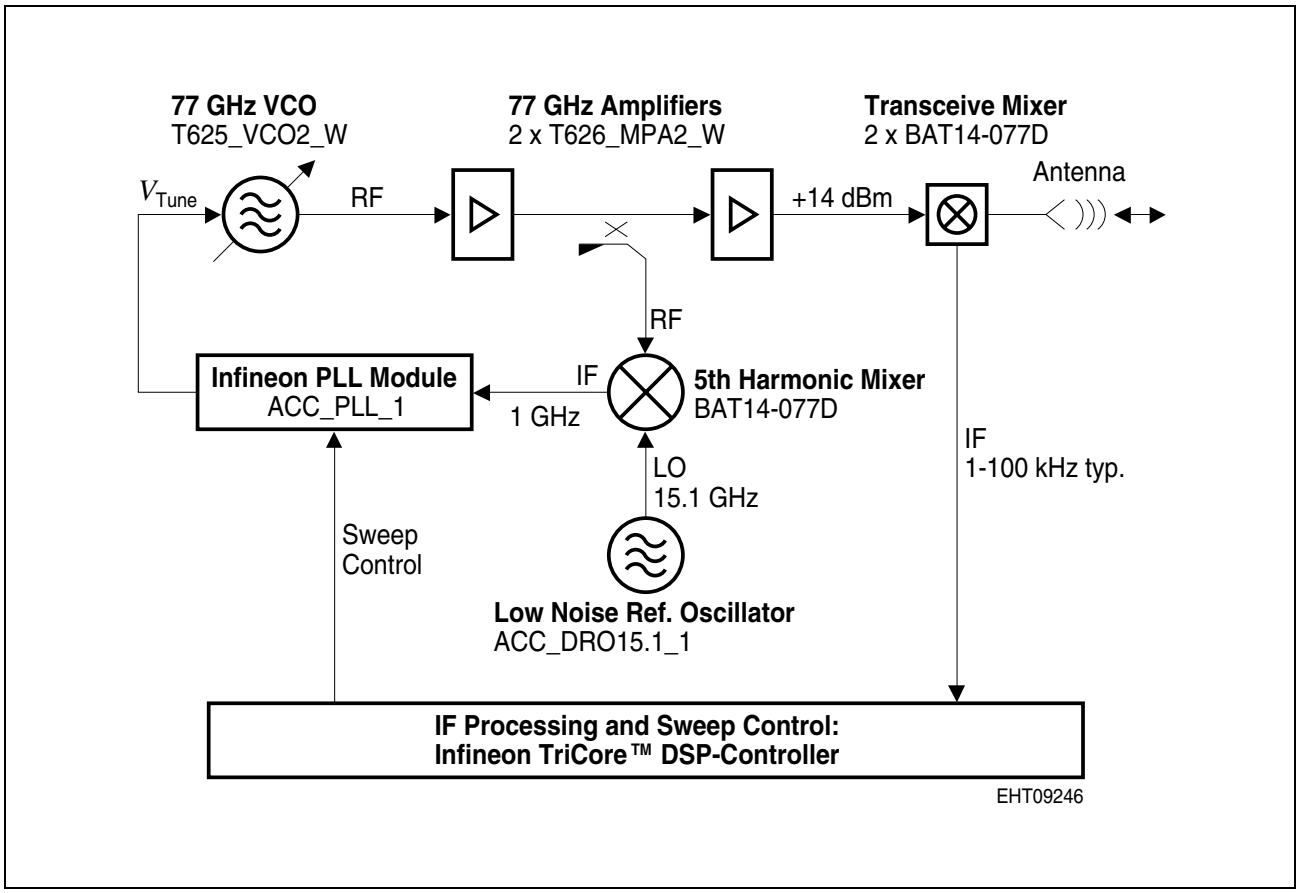

Figure 2 Principle of a Modern one-beam, MMIC-based FMCW Radar System

T625_VCO2_W	PHEMT-based 76 - 77 GHz, two-stage voltage controlled oscillator (VCO) GaAs MMIC with + 5 dBm output power.
T626_MPA2_W	PHEMT-based 76 - 77 GHz, two-stage medium power amplifier (MPA) with max. + 13.5 dBm RF output power and 10 dB small-signal gain at 76.5 GHz.
BAT14-077D	Silicon-based dual Schottky diode for millimeter wave receive mixer applications, 12 dB conversion loss, low 1/*f* corner frequency, very low noise.
ACC_DRO15.1_1[1)]	Ultra-low phase noise (– 108 dB/Hz @ 100 kHz) dielectric resonator oscillator (DRO) module as stable frequency reference with excellent short-term and long-term stability. Pre-tuned to 15.1 GHz.
ACC_PLL_1[1)]	Phase locked loop (PLL) module for the generation of ultra-linear frequency sweeps in FMCW radar systems. Typical deviation from a 200 MHz RF sweep at 76.5 GHz is less than 20 kHz. Maximum sweep bandwidth: 450 MHz, modulation rate 500 GHz/s. User control by simple digital interface or by an external data generator.
TriCore[1)]	TriCore™ microcontroller with two fast, synchronous A/D converters. Especially suited for signal processing and sweep control.

[1)] Contact Infineon for more information and design support.

Application Note: Biasing of Infineon PHEMT-Based Car Radar MMICs

Infineon car radar MMICs provide on-chip blocking capacitors, capable to reduce bias oscillations down to 1 GHz. For save operation below 1 GHz, a bypass capacitor of 470 to 330 pF should be connected from each MMIC gate terminal to an on-chip ground pad. The capacitor should have low ESR up to 1.5 GHz. Keep leads as short as possible.

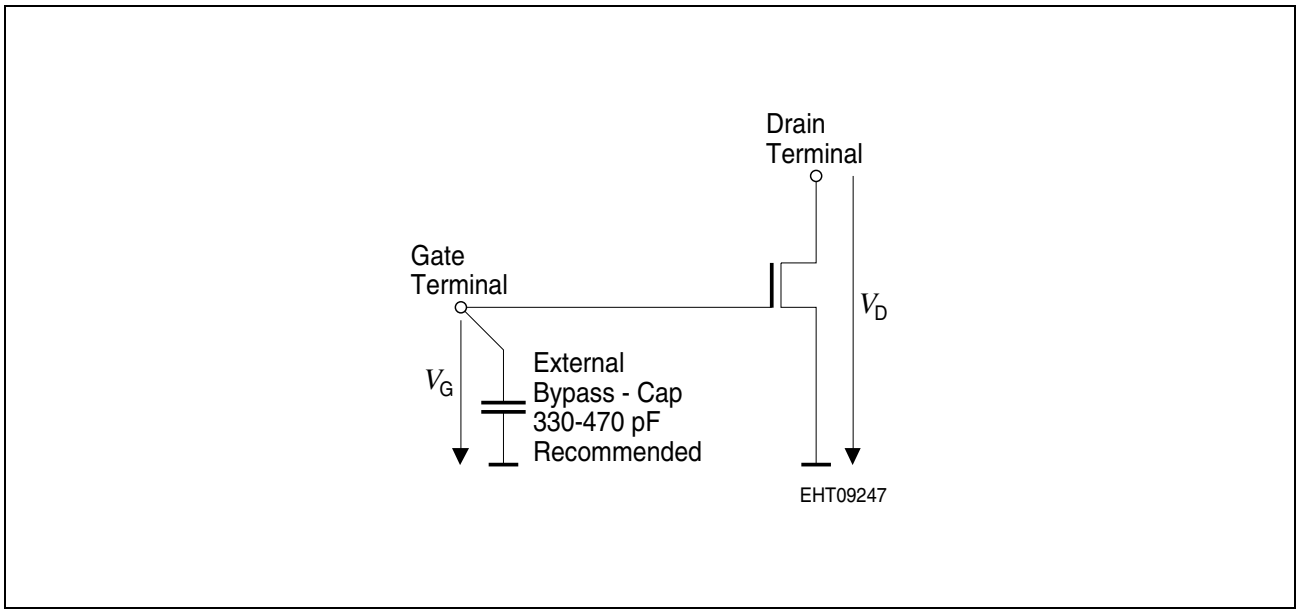

Figure 3

DC-Blocking of drain terminals is normally not necessary and might lead to bias oscillations induced by feedback via common ground lead inductance. Combination of drain and gate terminals should be done by series resistors of 5 to 10 Ω.

To compensate for temperature effects, an active bias controller with positive temperature coefficient (e.g. Infineon BCR 400W) can be used.