22 GHz – 57 GHz GaAs Driver Amplifier

AMM-7210

UC Module

Bare Die

1. Device Overview

1.1 General Description

The AMM-7210 is a general-purpose broadband MMIC driver amplifier that provides +21 dBm output power suitable for driving a Marki H or L diode mixer at 22-57 GHz and S diode mixer from 25-50 GHz. The small die size allows it to be used in a variety of applications, and has built in DC-blocking capacitors on the input and output.

Note: Not recommended, see AMM-8211 for new design. Email support for any questions.

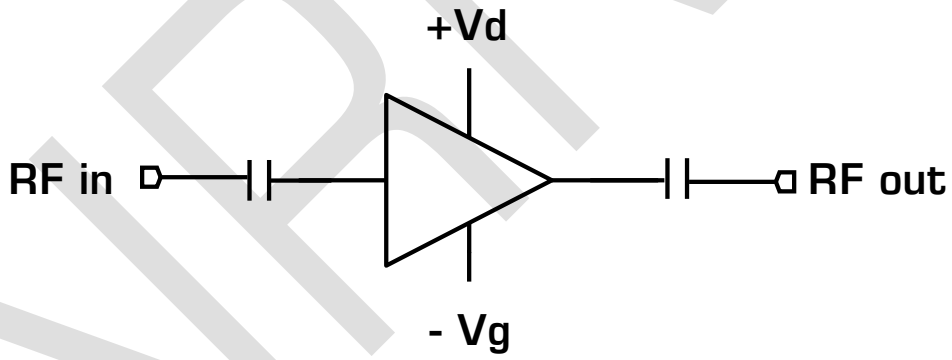
1.2 Features

- +21 dBm Output Power
- Broadband Performance
- Small Die size
- .s2p S-Parameters: AMM-7210CH

1.3 Applications

- Mobile test and measurement equipment
- Radar and satellite communications
- 5G Transceivers
- Driver amplifier L,H,S – diode mixers

1.4 Functional Block Diagram



1.5 Part Ordering Options[1]

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
AMM-7210CH	Wire Bondable Die	Bare Die	**RoHS**	Active	3A001.b.2.d
AMM-7210UC	Connectorized Module	UC	**RoHS**	Active	EAR99

[1] Refer to our website for a list of definitions for terminology presented in this table.

Table of Contents

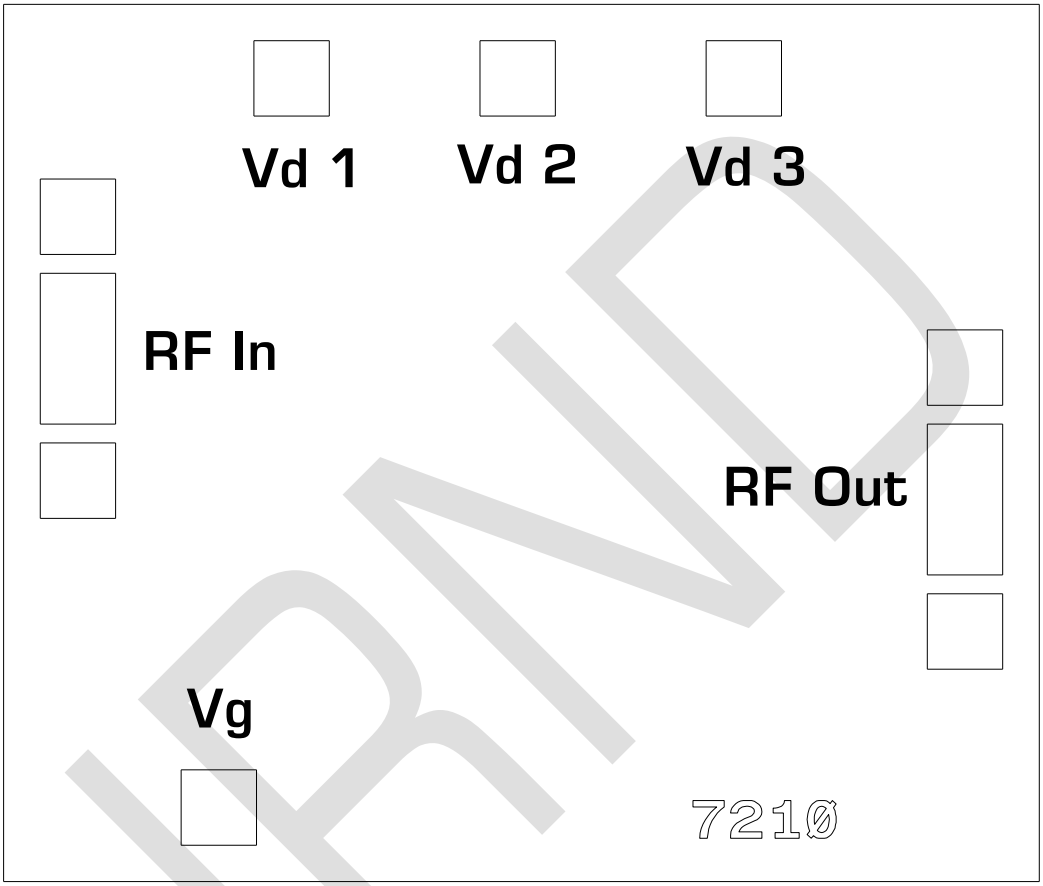
Revision History

Revision Code	Revision Date	Comment
-	May 2021	Datasheet Initial Release

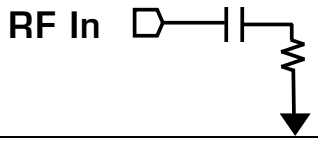
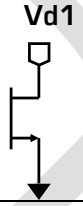
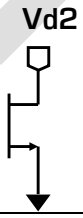
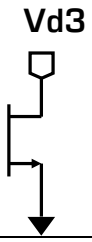
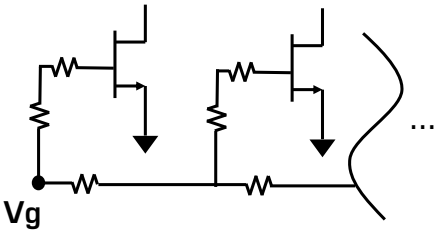
2. AMM-7210 Port Configurations and Functions

2.1 AMM-7210CH Port Diagram

A port diagram of the AMM-7210CH is shown below.

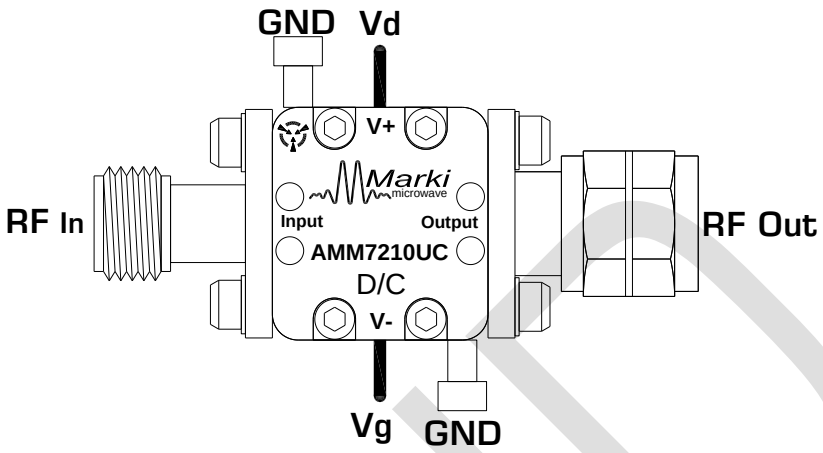


2.2 AMM-7210CH Port Functions

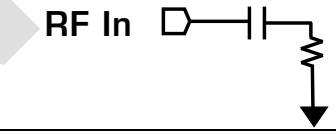
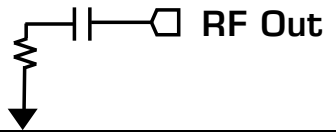
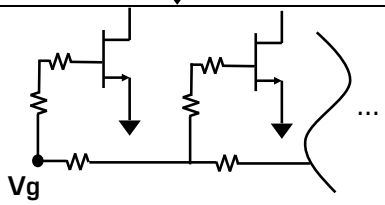
Port	Function	Description	Equivalent Circuit for Package
RF In	RF Input	This is the RF Input port of the amplifier die. It is internally DC blocked and RF matched to 50 Ω. RF input pad is GSG with 175 µm pitch.	
RF Out	RF Output	This is the RF Output port of the amplifier die. It is internally DC blocked and RF matched to 50 Ω. RF output pad is GSG with 175 µm pitch.	
Vd 1	Drain Supply Port 1	Pad Vd 1 supplies drain voltage to the first stage of the 3-stage amplifier IC. **Apply gate voltage Vg before applying drain voltage.**	
Vd 2	Drain Supply Port 2	Pad Vd 2 supplies drain voltage to the second stage of the 3-stage amplifier IC. **Apply gate voltage Vg before applying drain voltage.**	
Vd 3	Drain Supply Port 3	Pad Vd 3 supplies drain voltage to the third stage of the 3-stage amplifier IC. **Apply gate voltage Vg before applying drain voltage.**	
Vg	Gate Bias Voltage Pad	The Vg pad is connected resistively on chip. The user should apply between -0.4V and -0.6V to Vg pad before applying positive DC voltage to any Vd port. Lower (more negative) voltages on a Vg pad will result in lower drain current and lower small signal gain.	
GND	Ground	Bottom side must be connected to a DC/RF ground potential with high thermal and electrical conductivity.	

2.3 AMM-7210UC Port Diagram

A port diagram of the AMM-7210UC is shown below.



2.4 AMM-7210UC Port Functions

Port	Function	Description	Equivalent Circuit for Package
RF In	RF Input	This is the RF Input port of the amplifier module. It is internally DC blocked and RF matched to 50 Ω.	
RF Out	RF Output	This is the RF Output port of the amplifier module. It is internally DC blocked and RF matched to 50 Ω.	
Vd	Drain Supply Pin	The Vd pin supplies drain voltage to the amplifier IC. **Apply gate voltage Vg before applying drain voltage.**	
Vg	Gate Bias Pin	The Vg pin supplies negative control voltage to the amplifier and controls the amplifier gain. Lower (more negative) voltages on a Vg pad will result in lower drain current and lower small signal gain.	
GND	Ground	Exterior housing must be connected to a DC/RF ground potential with high thermal and electrical conductivity.	

3. Specifications

3.1 Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded, the device may become inoperable or have a reduced lifetime. This amplifier is designed and characterized in a 50Ω system, and operation in a reflective environment can cause performance degradation.

Parameter	Maximum Rating	Units
Positive Drain Supply Voltage (Vd)	4.5	V
Negative Bias Voltage (Vg)	-2	V
Positive Drain Supply Current (Id) (with RF Input)	450	mA
RF Input Power	+20	dBm
Operating Temperature	-40 to +85	°C
Storage Temperature	-65 to +150	°C
Thermal Resistance, θ_{JC}	90	°C/W
Continuous Power Dissipation (P_{DISS}) (at 85 °C case temp.)[2]	1	W
Max Junction Temperature for MTTF > 1E6 hours	175	°C

3.2 Package Information

Parameter	Details	Rating
Weight	AMM-7210UC	12.4g

[2] Derates by 11 mW/ °C above 85 °C case temperature.

3.3 Recommended Operating Conditions

The Recommended Operating Conditions indicate the limits, inside which the device should be operated, to guarantee the performance given in Electrical Specifications Operating outside these limits may not necessarily cause damage to the device, but the performance may degrade outside the limits of the electrical specifications. For limits, above which damage may occur, see Absolute Maximum Ratings.

Recommended Operating Conditions – CH bare die package[3]	Min	Nominal	Max	Units
T_A, Ambient Temperature	-40	+25	+85	°C
Power Supply DC Voltage (Vd)	+2.5	+3	+4	V
Power Supply DC Current (Id) (No RF Input)	115	180	300	mA
Negative Bias Voltage (Vg)	-0.6	-0.5	-0.4	V
Input Power for Saturation	+8	+11	+13	dBm

Recommended Operating Conditions – UC connectorized module package[4]	Min	Nominal	Max	Units
T_A, Ambient Temperature	-40	+25	+85	°C
Power Supply DC Voltage (Vd)	+2.5	+3	+4	V
Power Supply DC Current (Id) (No RF Input)	115	180	300	mA
Negative Bias Voltage (Vg)	-0.6	-0.5	-0.4	V
Input Power for Saturation	+8	+11	+13	dBm

3.4 AMM-7210CH and AMM-7210UC Sequencing Requirements

Turn-on Procedure:

1) Apply negative bias to Vg
2) Apply Vd

Turn-off Procedure:

1) Turn off Vd
2) Turn off Vg

Note: RF input power can be injected at any moment in the bias sequencing procedure.

[3] Power Supply DC current should be modified by changing bias voltage Vg to maintain junction temperature within MTTF target for given operating conditions.
[4] Module conditions provided for laboratory settings. Bare die operating conditions should be followed when used in test systems with extended lifetimes.

3.5 Electrical Specifications

The electrical specifications apply at T_A=+25°C in a 50Ω system.

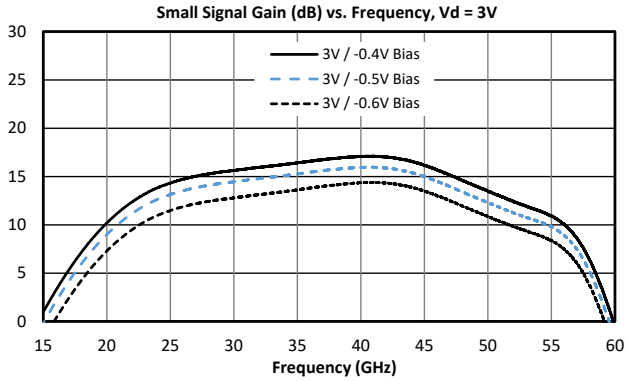
Min and Max limits apply only to our connectorized units and are guaranteed at T_A=+25°C. Die are 100% DC tested and RF tested on a per lot basis

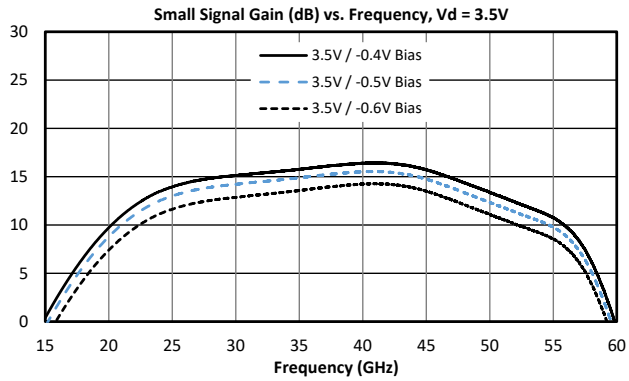
Parameter	Test Conditions	Frequency	Min	Typical	Units
Saturated Output Power[5]	3V/-0.5V bias	22 GHz – 30 GHz		+19	dBm
		30 GHz – 48 GHz	+17	+20.5	
		48 GHz – 57 GHz		+18	
Small Signal Gain	3V/-0.5V bias	22 GHz – 30 GHz		13	dB
		30 GHz – 48 GHz	10	14.5	
		45 GHz – 57 GHz		11	
Input Return Loss	3V/-0.5V Bias	22 GHz – 57 GHz		14	
Output Return Loss		22 GHz – 57 GHz		14	
Reverse Isolation		22 GHz – 57 GHz		47	
Noise Figure	3V/-0.5V bias	22 GHz – 57 GHz		6.3	
Bias Requirements[6]	3V/-0.4V	-		230	mA
	3V/-0.5V	-		180	
	3V/-0.6V	-		130	
Input IP3 (IIP3)	3V/-0.5V, -20 dBm Input Power	22 GHz – 57 GHz		+13	dBm
Output IP3 (OIP3)		22 GHz – 57 GHz		+27	
Output P_{1dB}	3V/-0.5V bias	22 GHz – 57 GHz		+19	
Input Power for Saturation	3V/-0.5V bias	22 GHz – 57 GHz		+11	dBm

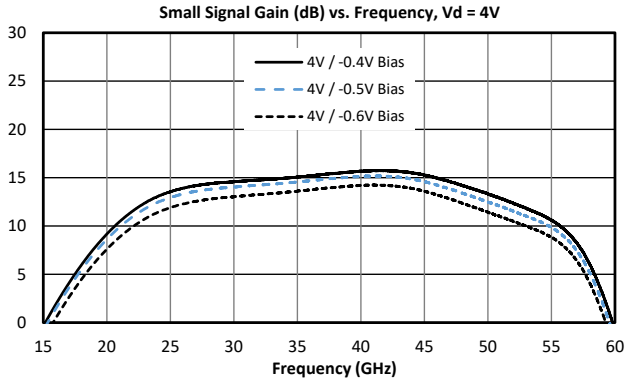
[5] Saturated Output Power specification defined using the AMM-7210UC P5dB compression curve shown in section 3.7.

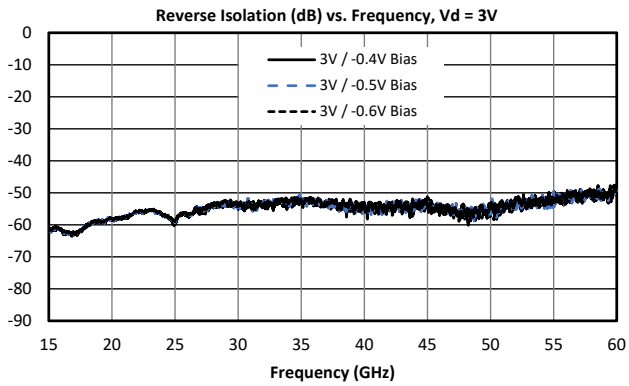
[6] Bias conditions tested with no RF input power. Bias conditions presented as Vd/Vg.

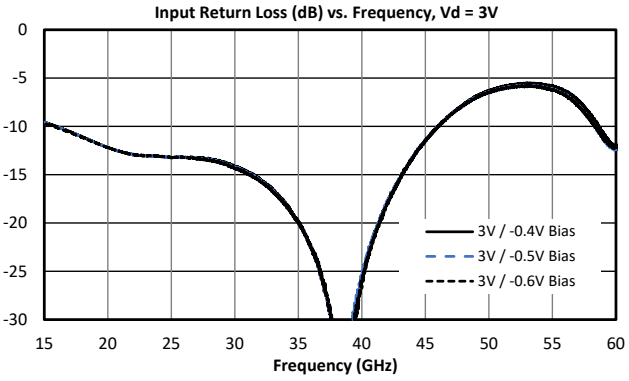
3.6 AMM-7210CH Typical Performance Plots

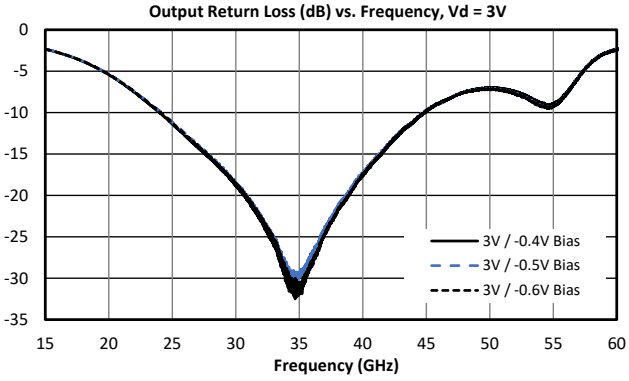




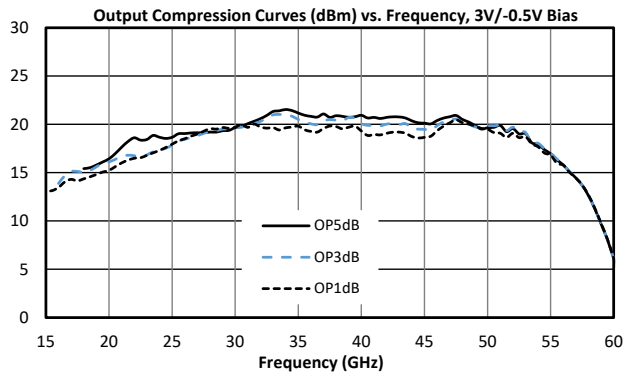


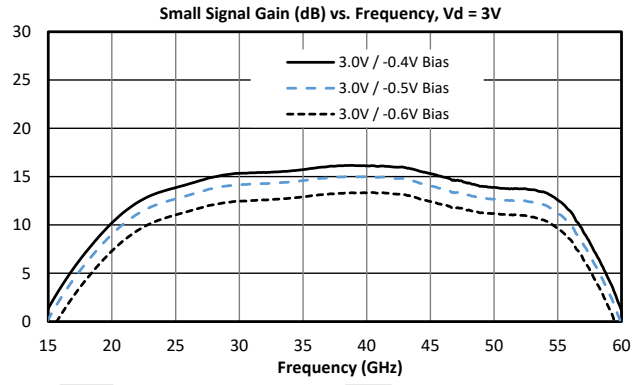


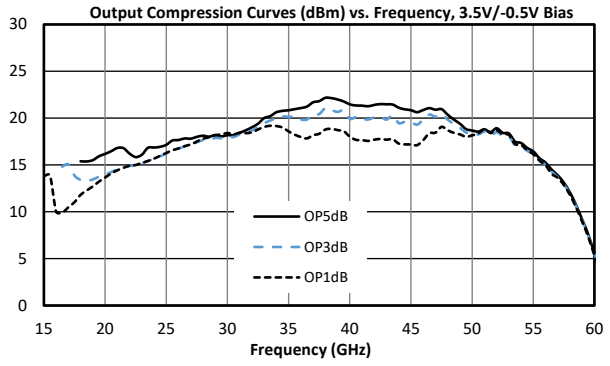


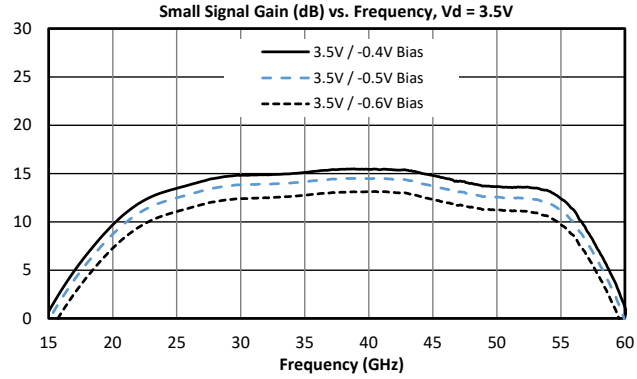


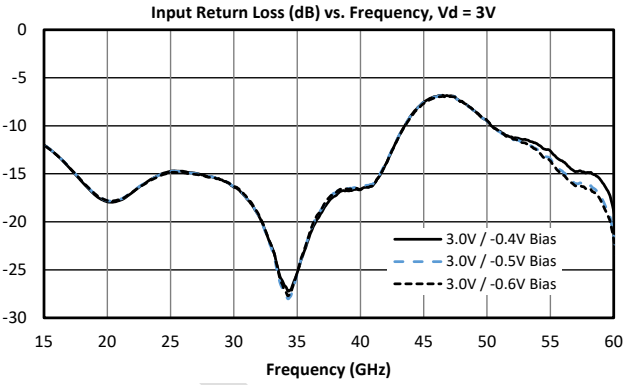
3.7 AMM-7210UC Typical Performance Plots

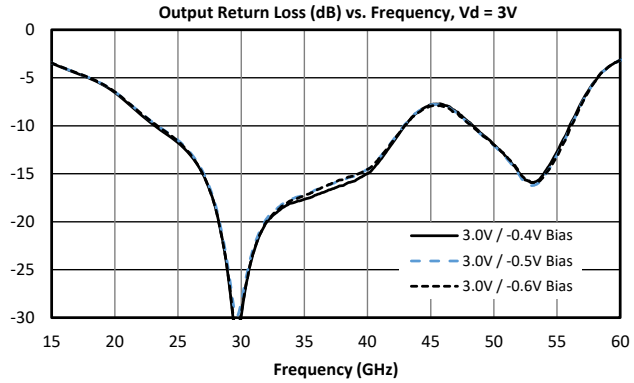


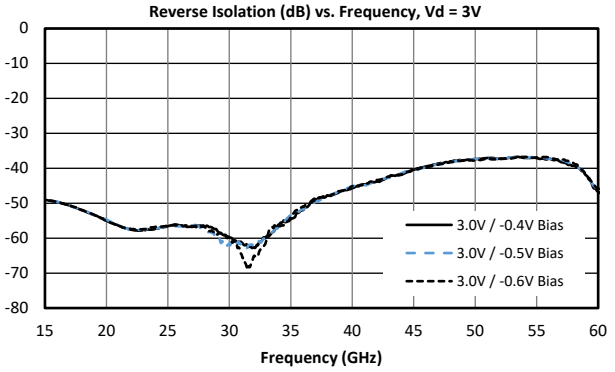


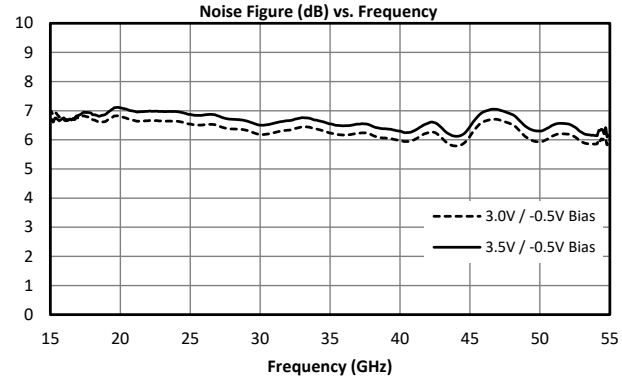


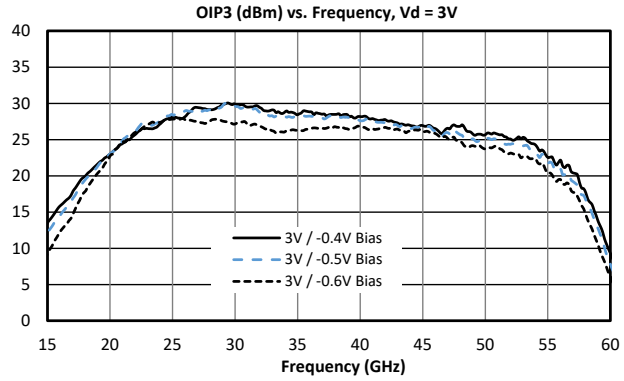


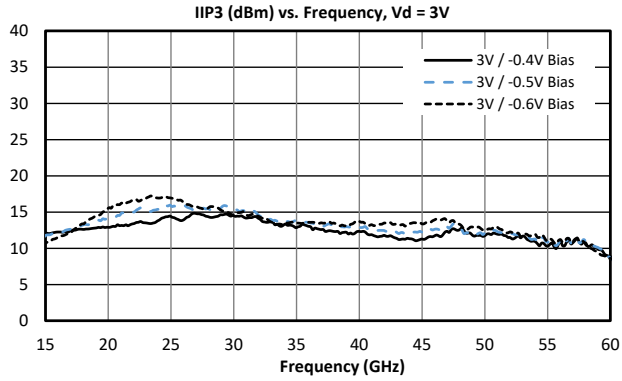


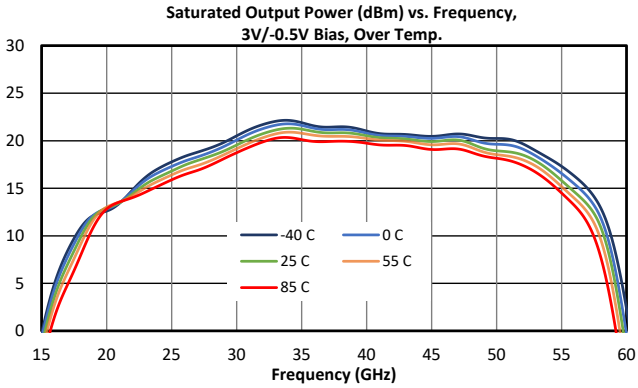


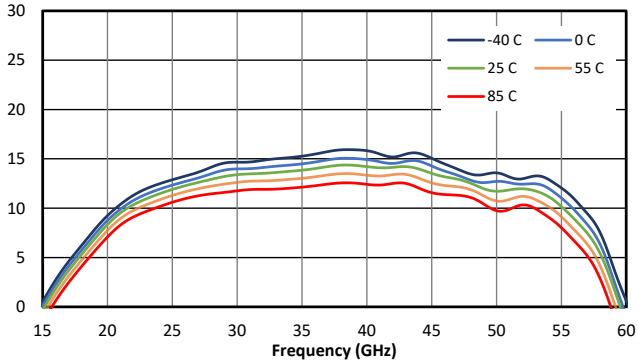


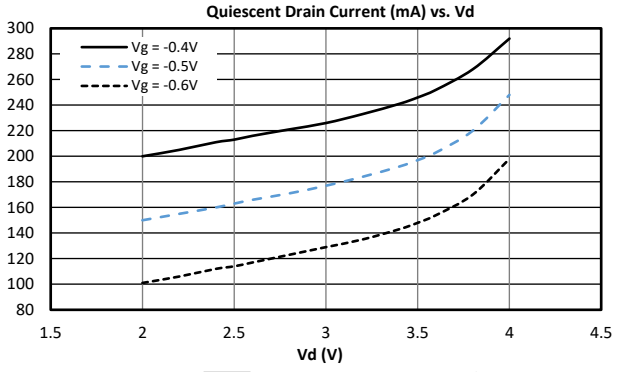


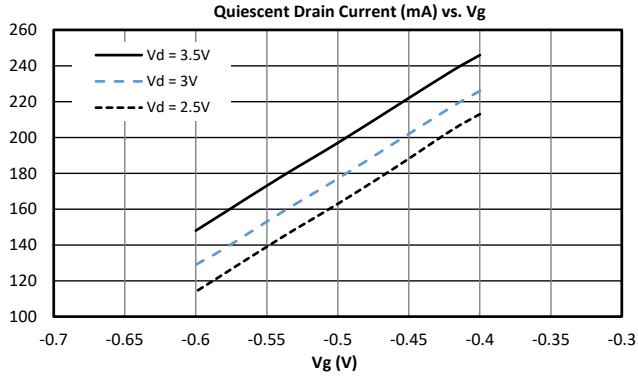


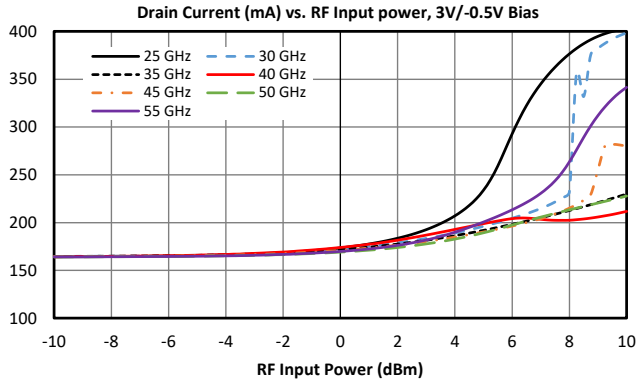












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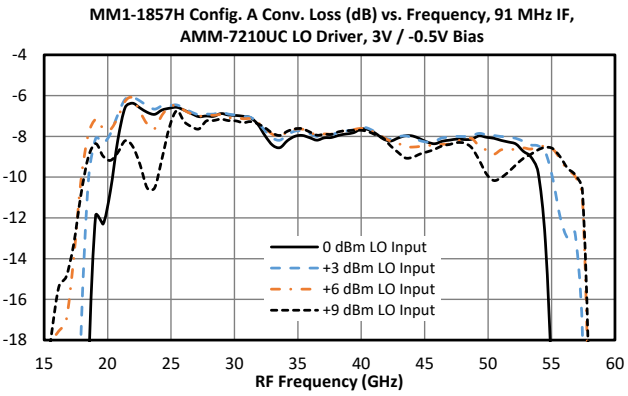
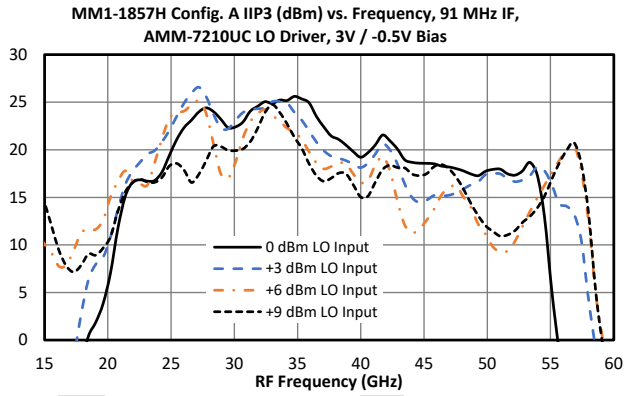
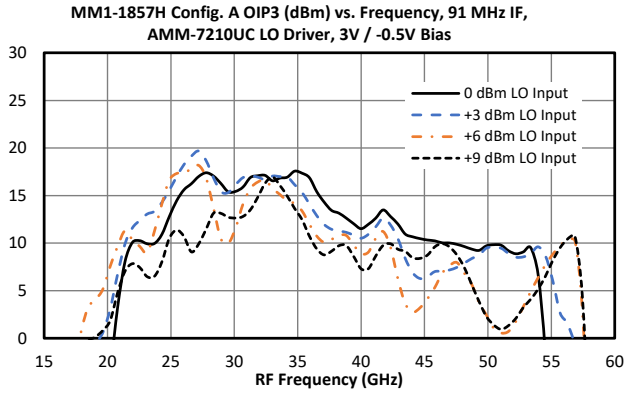
3.8 Typical Marki Mixer Performance Plots with AMM-7210UC LO Driver[7]





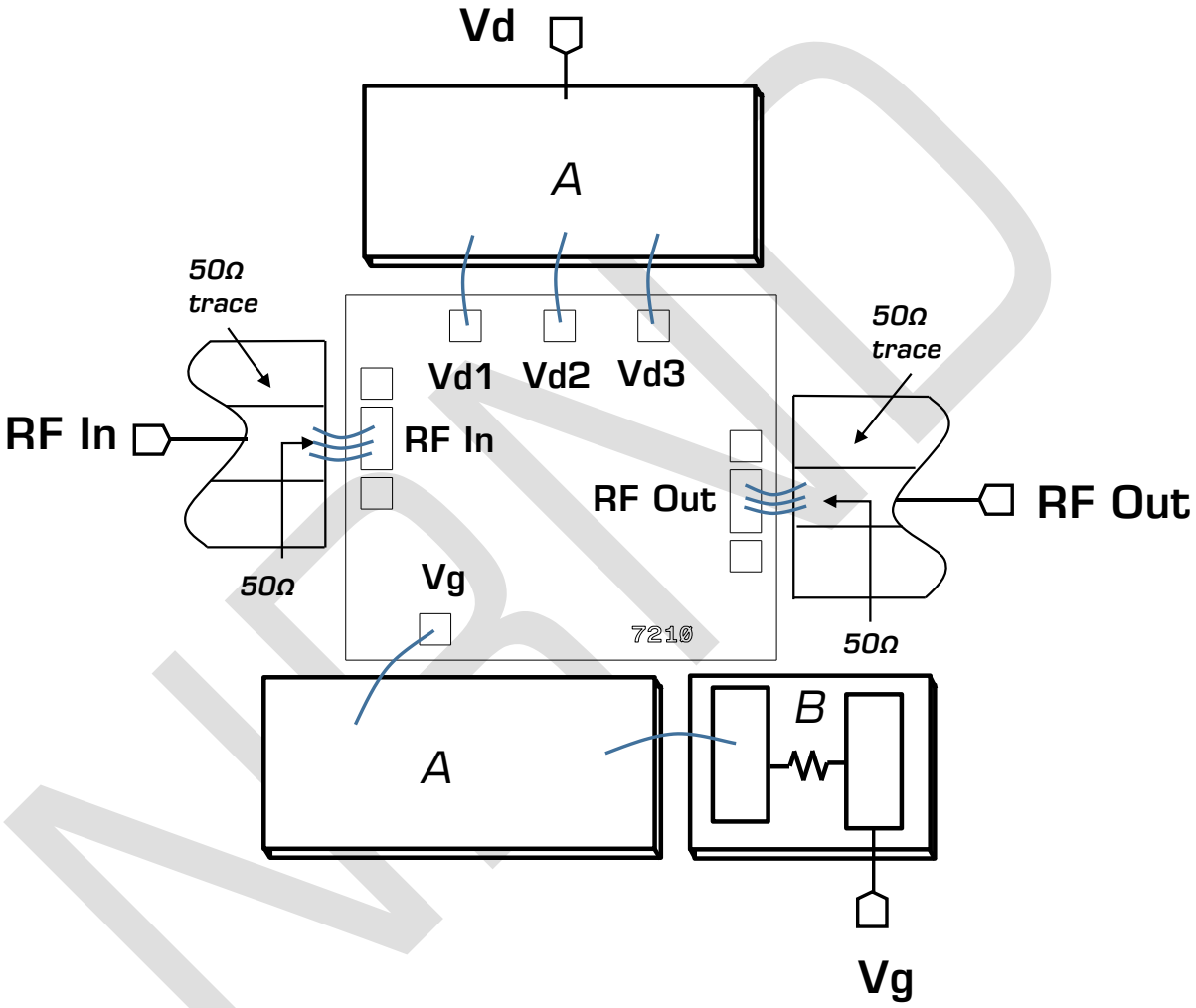


[7] LO Input Powers specified as the input power into the AMM-7210UC LO driver

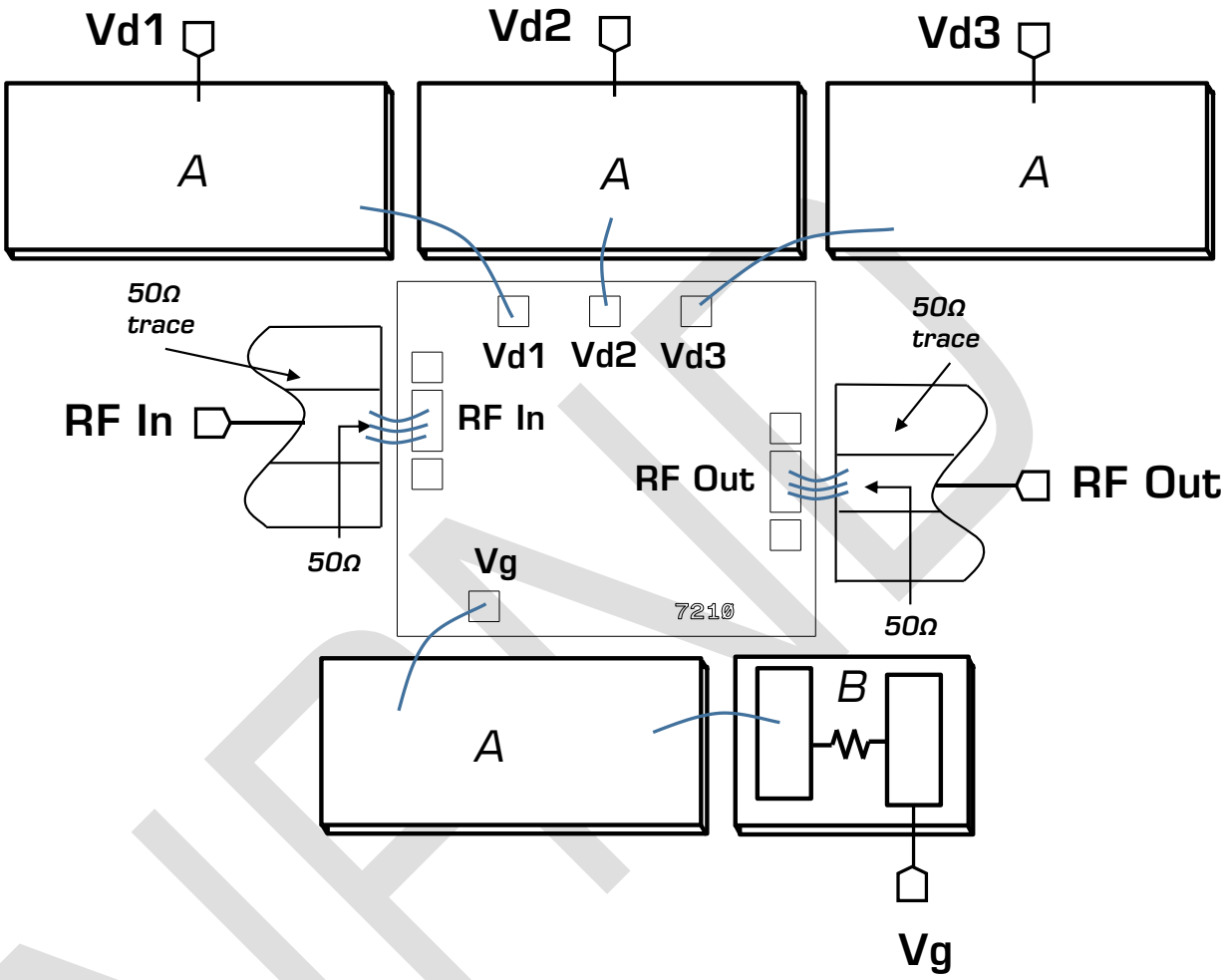
4. Application Information

4.1 AMM-7210CH Application Circuit

Below are the recommended application circuits for the AMM-7210CH. This application circuit is used for the performance plots shown in this datasheet. However, each PCB layout and environment are different which may require minor modifications of the biasing network. Please contact support@markimicrowave.com for more information.



One can also choose to break out Vd1, Vd2, and Vd3 to separate power supply lines to increase gain control and further strengthen amplifier stability.



Designator	Description	Sample Part Number
A	Presidio 0.1 µF + 1800 pF Capacitor	MVB4080X104ZGH5R3
B	PPI 10Ω Wire-bondable series resistor	PRT135-14x12x10A10R00FQE

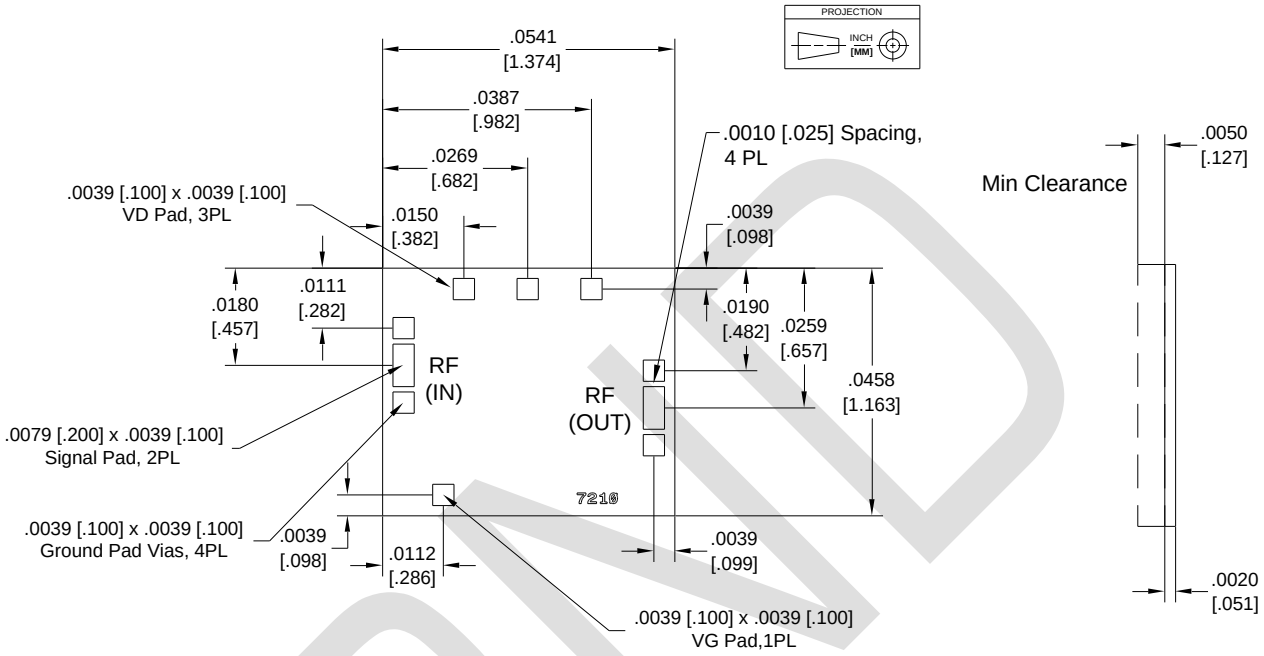
4.2 Constant Drain Current vs. Constant Gate Voltage Operation

The AMM-7210 pHEMT amplifier can be biased with a constant gate and drain voltage, or with a constant drain current by regulating the gate voltage. Using a constant gate and drain voltage reduces circuit complexity, but has variable current consumption during operation. However, regulating the gate voltage using feedback circuitry which controls the drain current to a constant value minimizes unit-to-unit variation in gain, output power, and compression points.

Under small signal excitation at a fixed temperature, these two approaches are equivalent because the current draw versus frequency is relatively constant in small signal. However, they will diverge in large signal conditions, where the drain current is affected the input signal's frequency and power. The output power in saturation is relatively unchanged, as it is more strongly dependent on the drain voltage. However, output referred 1 dB compression point will decrease by 2-3 dB when operated with a constant drain current.

5. Mechanical Data

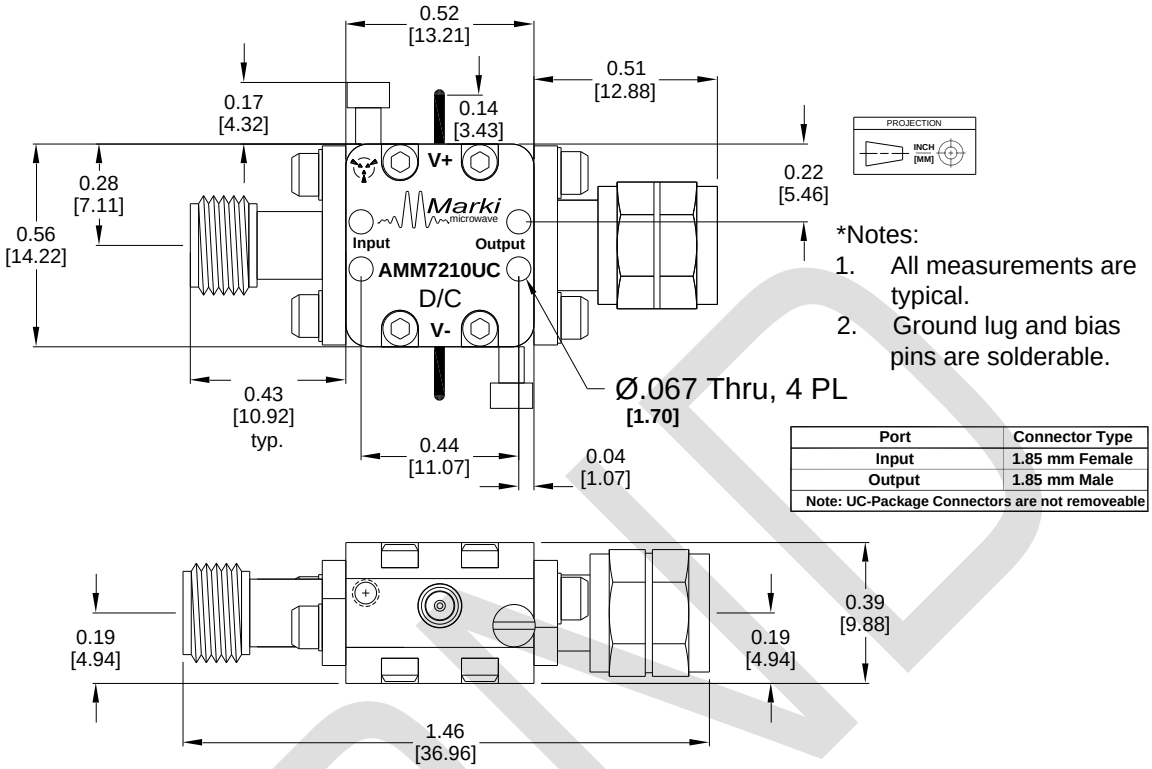
5.1 AMM-7210CH Outline Drawing



Notes:

1) RF GSG probe pitch is 175 µm.
2) CH substrate is 0.002 inches thick GaAs.
3) I/O trace finish is 4 µm Au. Ground finish is 5 µm Au.
4) Die are not passivated

5.2 AMM-7210UC Package Outline Drawing



*Notes:
1. All measurements are typical.
2. Ground lug and bias pins are solderable.

Port	Connector Type
Input	1.85 mm Female
Output	1.85 mm Male
Note: UC-Package Connectors are not removeable	

