# 24-24.5GHz Tx Multifunction

## GaAs Monolithic Microwave IC in SMD leadless package

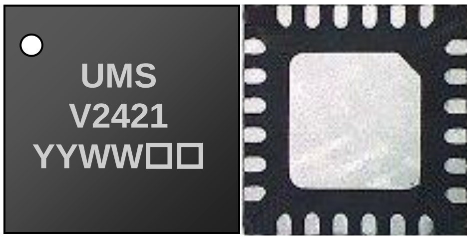
## Description

The CHV2421-QDG is a monolithic multifunction for dual channel frequency generation. It integrates a X-band "push-push" oscillator with frequency control thanks to base collector diodes, used as varactors, two K-Band buffers with a "Mute" power control command ($M_1$ ,$M_2$) for each output, and a frequency divider by 8.

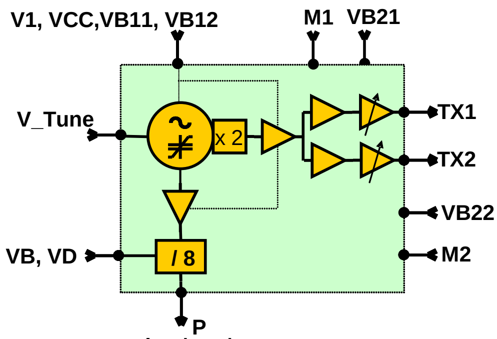
The circuit is dedicated to sensors and also well suited for a wide range of microwave and millimeter wave applications and systems.

The circuit is manufactured with a standard InGaP HBT process, 2µm emitter length, via holes through the substrate, and high Q passive elements.

It is supplied in a 24 leads RoHS compliant QFN4x4 package.



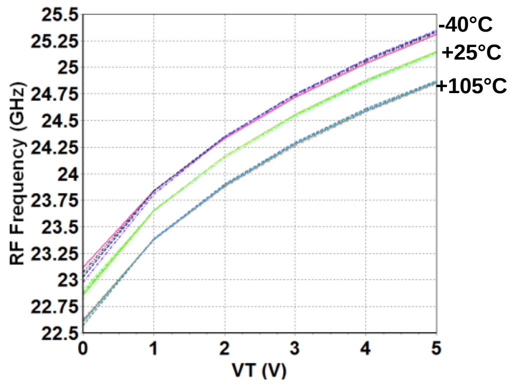

Plastic package




Block Diagram

## Main Features

- 24-24.5GHz frequency tuning range
- -90dB/Hz phase Noise
- 15dBm typical output power
- +5V single supply Voltage
- 24L-QFN 4x4 SMD leadless package
- MSL1




Frequency vs tuning voltage (-40/25/105°C)

## Main Electrical Characteristics

Tamb.= +25°C

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Freq | Frequency range | 24 | | 24.5 | GHz |
| P_TXn | Typical output power on both channel | | 15 | | dBm |
| PN | Phase Noise @ 100kHz | | -90 | -80 | dBc/Hz |
| PW_TX_16 | Prescaler Output Power | | 0 | | dBm |
| V_Tune | Tuning Voltage | 0.5 | | 5.5 | V |



**United Monolithic Semiconductors S.A.S.**
**10 Avenue du Québec – SILIC 521 - 91946 Courtaboeuf Cedex France**
**Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34**

## Electrical Characteristics

Temp.= -40°C to +105°C

| Symbol | Parameter | Min | Typ | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| F_TX | Output Frequency | 24 | | 24.5 | GHz | |
| F_VCO | Core VCO frequency | F_Tx/2 | | | GHz | |
| V_Tune | Voltage Tuning within F_TX | 0.5 | | 5.5 | V | |
| T_sens | Tuning sensitivity within F_TX | 225 | 450 | 850 | MHz/V | |
| F_drift | Temperature frequency drift rate | | 3 | 5 | MHz/°C | |
| H1 | Harmonics ½ F_TX power (TX1 & TX2 ports) | | -15 | -5 | dBm | |
| H3 | Harmonics 3/2 F_TX power (TX1 & TX2 ports) | | -45 | -30 | dBm | |
| H4 | Harmonics 2 F_TX power (TX1 & TX2 ports) | | -40 | -25 | dBm | |
| Sp_TX | Non-harmonic spurious rejection at TX1, TX2 ports | 70 | 80 | | dBc | |
| Pres_TX | Prescaler spurious rejection at TX1, TX2 ports | 45 | 55 | | dBc | |
| PN | SSB Phase Noise @ 100KHz at TXn | | - 90 | - 80 | dBc/Hz | |
| VSWR_RF | RF Output (TX1, TX2) VSWR | | 1,5:1 | 2,5:1 | | VB21, VB22>3.15V |
| LP_RF | RF Load Pulling into 2.5:1 VSWR all phases (Tx1, Tx2) | | | 8 | MHz | |
| Push | Bias pushing (VCC, VB, VD, V1, VB11, VB12, VB21, VB22, M1, M2) | | 50 | 250 | MHz/V | |
| P_TX1 (1) | Nominal output Power on TX1 | 10.5 | 15.5 | 18.5 | dBm | 4.9<Supplies<5.1V M1_v<0.2V or NC |
| P_TX1_T°C | P_TX1 Temperature coefficient | -2e-4 *T - 0.0219 | | | dB/°C | dP/dT |
| P_TX2 (1) | Nominal output Power on TX2 | 9.5 | 15 | 19.5 | dBm | 4.9<Supplies<5.1V M1_v<0.2V or NC |
| P_TX2_T°C | P_TX2 Temperature coefficient | -4e-4 *T - 0.0179 | | | dB/°C | dP/dT |
| D_P_TXn | Output Power Dynamic Range on TX1 & TX2 with VB2n controlled | 8 | 13 | | dB | |
| L_P_TXn | Low Power level on TXn with VB2n<2.25V | | | 8.75 | dBm | |
| P_TX1_LO (2) | TX1 Power if VB21=3.3V & M1_v<0.2V/NC | 1 | 6 | 10 | dBm | |
| P_TX2_OFF | TX2 Power if VB22<2.25V & M2_v>3.15V | | -14 | -7 | dBm | |



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## Electrical Characteristics (Cont.)

| | | | | | | |
|---|---|---|---|---|---|---|
| F_TX_16 | TX_16 Output Frequency | F_TX/16 | | | GHz | |
| L_TX_16 | TX_16 Output Load | | 50 | | Ω | |
| PW_TX_16 | TX_16 Output Power | -4 | 0 | 3.5 | dBm | |
| Pres_SWP | Prescaler VD switching pulling | | 8 | 15 | MHz | |
| VB21, VB22 | VB2n Control voltage range for P_TXn power<br>Highest level<br>Lowest level | <br><br>4.7<br>1.75 | | <br><br>5.3<br>2.25 | V | |
| Mn_v | Txn Mute control voltage<br>Mute ON<br>Mute OFF | <br>4.7<br>0 | | <br>5.3<br>0.2 or NC | V | |
| T_Mute | Mute recovery time | | 100 | 250 | µs | |
| VCC, VB, VD, V1, VB11, VB12 | Supply voltage | 4.7 | 5 | 5.3 | V | |
| I_VCC | Supply Current on VCC | | 50 | 75 | mA | |
| I_VB | Supply Current on VB | | 10 | 14 | mA | |
| I_VD | Supply Current on VD | | 80 | 140 | mA | |
| I_V1 | Supply Current on V1 | | 13 | 21 | mA | |
| I_VB1n | Supply Current on VB11 or VB12 | | 23 | 32 | mA | |
| I_VB2n | Supply Current on VB21 or VB22 | | 45 | 70 | mA | |
| I_Mn | Max Supply Current on M1 or M2 | | 2 | 3.5 | mA | |
| Top | Operating temperature range | -40 | | +105 | °C | Top=Tcase |

(1) As measured on UMS recommended test fixture.
(2) Recommended configuration to reduce TX1 output power range to feed a single CHR2421.

Packaged TX is conditionally Stable (Stability guaranteed on UMS demo-board and for RF loads VSWR <3:1).

Full temperature and supply voltage range.



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## Absolute Maximum Ratings

Tamb.= +25°C

| Symbol | Parameters | Values | Unit |
|---|---|---|---|
| VCC, VB, VD, V1, VB11, VB12, VB21, VB22, M1, M2 | Maximum positive supply voltage (1)<br>Minimum positive supply voltage (1) | 6<br>-0.5 | V |
| VT | Maximum positive supply voltage (1) (3)<br>Minimum positive supply voltage (1) | 10<br>-0.5 | V |
| +I_VT | VT Maximum positive supply current (1) | 2 | mA |
| +I_VCC | VCC Maximum positive supply current (1) | 85 | mA |
| +I_VB | VB Maximum positive supply current (1) | 20 | mA |
| +I_VD | VD Maximum positive supply current (1) | 140 | mA |
| +I_V1 | V1 Maximum positive supply current (1) | 30 | mA |
| +IVB1n | VB1n Maximum positive supply current (1) | 40 | mA |
| +IVB2n | VB2n Maximum positive supply current (1) | 80 | mA |
| +IMn | IMn Maximum positive supply current (1) | 4 | mA |
| Tj | Junction temperature (2) | 175 | °C |
| Top | Operating temperature range (2) | -40 to +125 | °C |
| Tstg | Storage temperature range | -55 to +150 | °C |

(1) Operation of this device above anyone of these parameters may cause permanent damage.
(2) Top=Tcase. Operation of this device above these parameters may cause permanent damage or reduce MTTF.
(3) Voltage applied through 220Ω serial resistor to limit VT current below 2mA DC, and duration should not exceed 1s.



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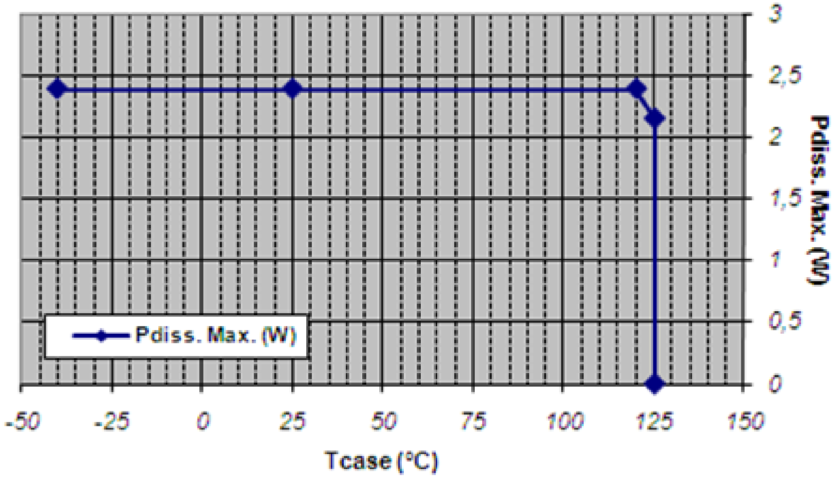
## Device thermal performances

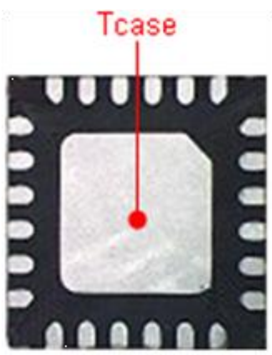
All the figures given in this section are obtained assuming that the QFN device is cooled down only by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase) as shown below.
The system maximum temperature must be adjusted in order to guarantee that Tcase remains below than the maximum value specified in the next table. So, the system PCB must be designed to comply with this requirement.

A derating must be applied on the dissipated power if the Tcase temperature can not be maintained below than the maximum temperature specified (see the curve Pdiss. Max) in order to guarantee the nominal device life time (MTTF).

| DEVICE THERMAL SPECIFICATION : | | | | | |
|---|---|---|---|---|---|
| Recommended max. junction temperature (Tj max)(1) | | | : | 150 | °C |
| Junction temperature absolute maximum rating | | | : | 175 | °C |
| Max. continuous dissipated power @ Tcase= | 105 | °C | : | 2,4 | W |
| => Pdiss derating above Tcase(2)= | 105 | °C | : | 47 | mW/°C |
| Junction-Case thermal resistance (Rth J-C)(3) | | | : | <21 | °C/W |
| Minimum Tcase operating temperature(4) | | | : | -40 | °C |
| Maximum Tcase operating temperature(4)(5) | | | : | 105 | °C |
| Absolute maximum rating Tcase temperature(4)(5) | | | : | 125 | °C |
| Minimum storage temperature | | | : | -55 | °C |
| Maximum storage temperature | | | : | 150 | °C |

*(1) Typical supply voltage considered @ Tcase=105°C.*
*(2) Derating at junction temperature constant = Tj max*
*(3) Rth J-C is calculated for a worst case where the* ***hottest junction*** *of the MMIC is considered, and all component biasing are supplied.*
*(4) Tcase=Package back side temperature measured under the die-attach-pad (see the drawing below).*
*(5) Typical supply voltage considered 5V*



Example: QFN 24L 4x4
Location of temperature reference point (Tcase) on package's bottom side



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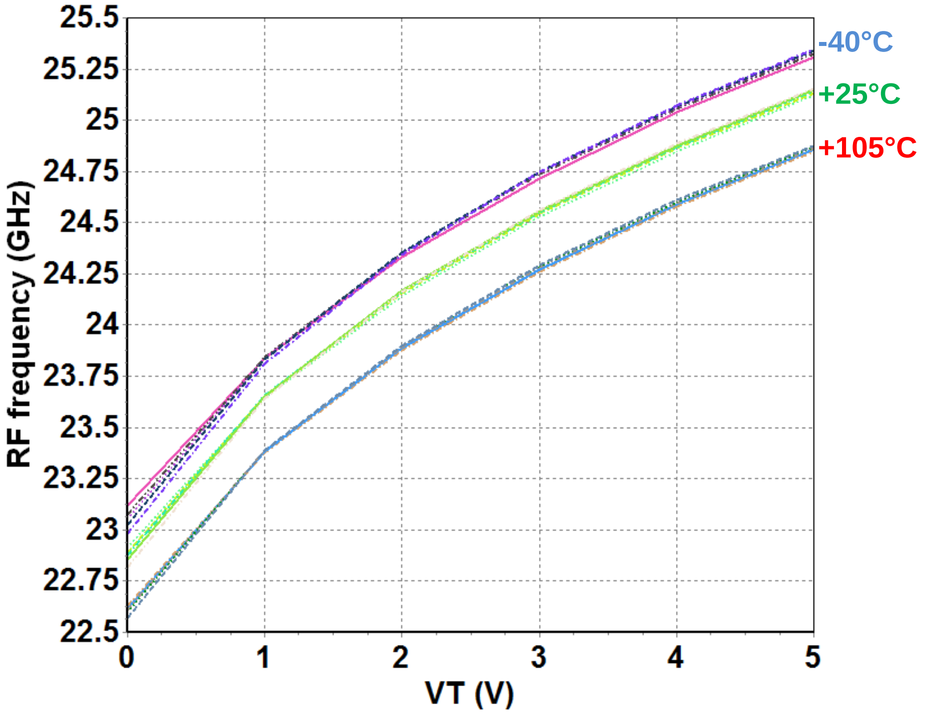
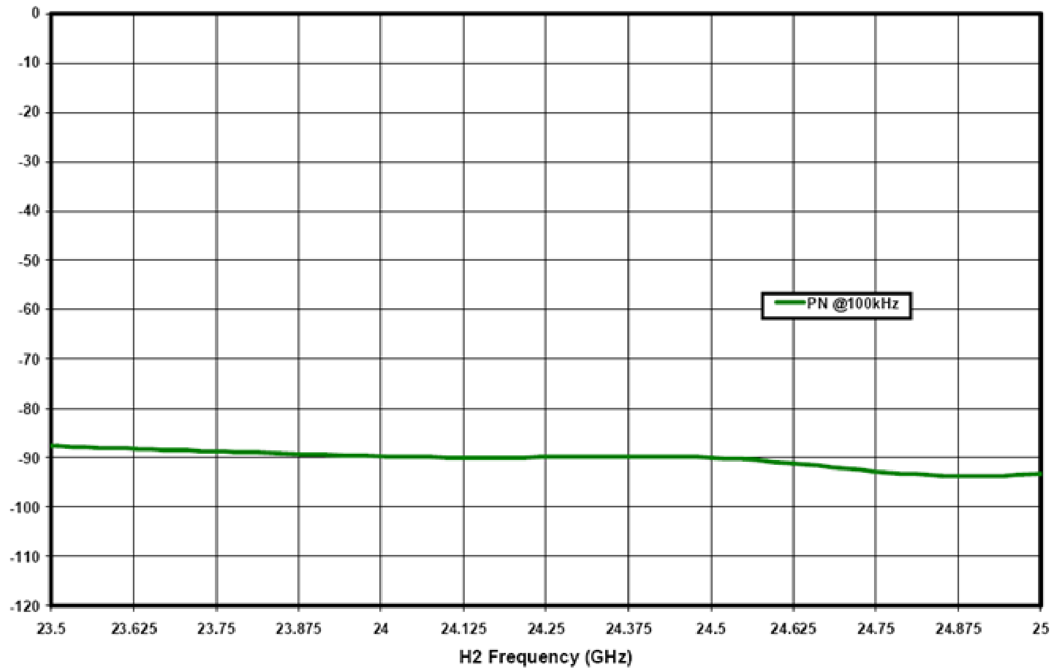
## Typical Board Measurements (QFN plan)

All supplies= +4.7V; +5V; +5.3V

### Typical Frequency over Tuning Voltage and Temperature




### Typical SSB Phase Noise @100kHz



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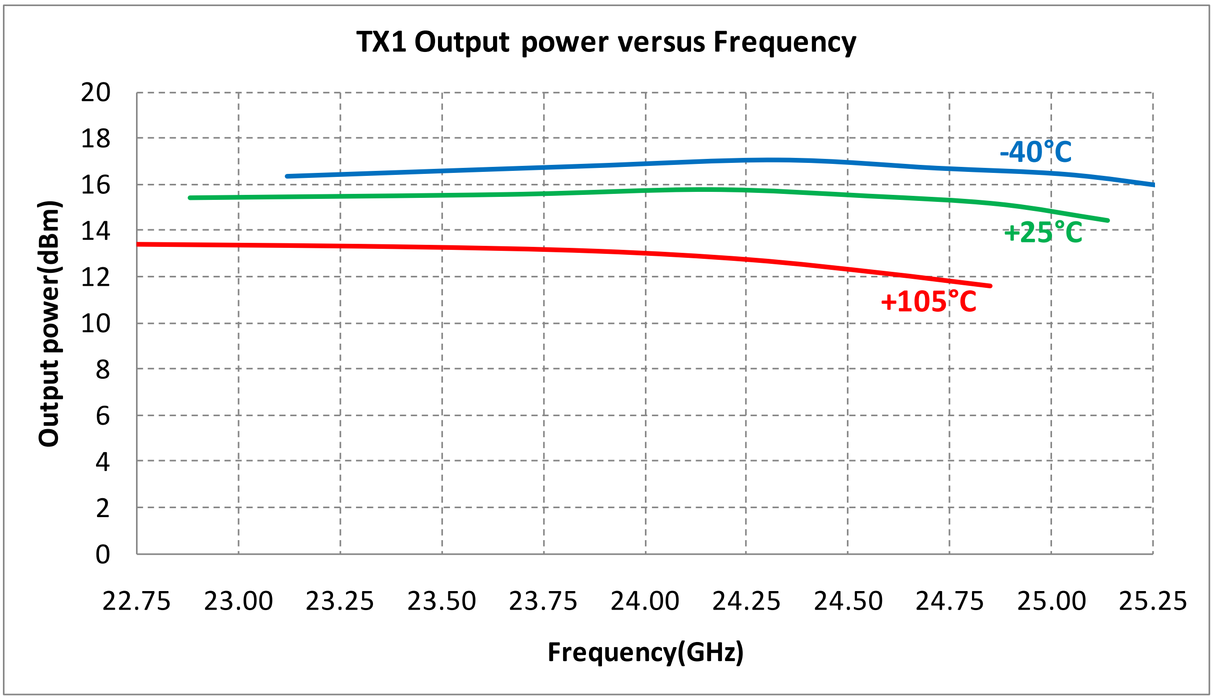
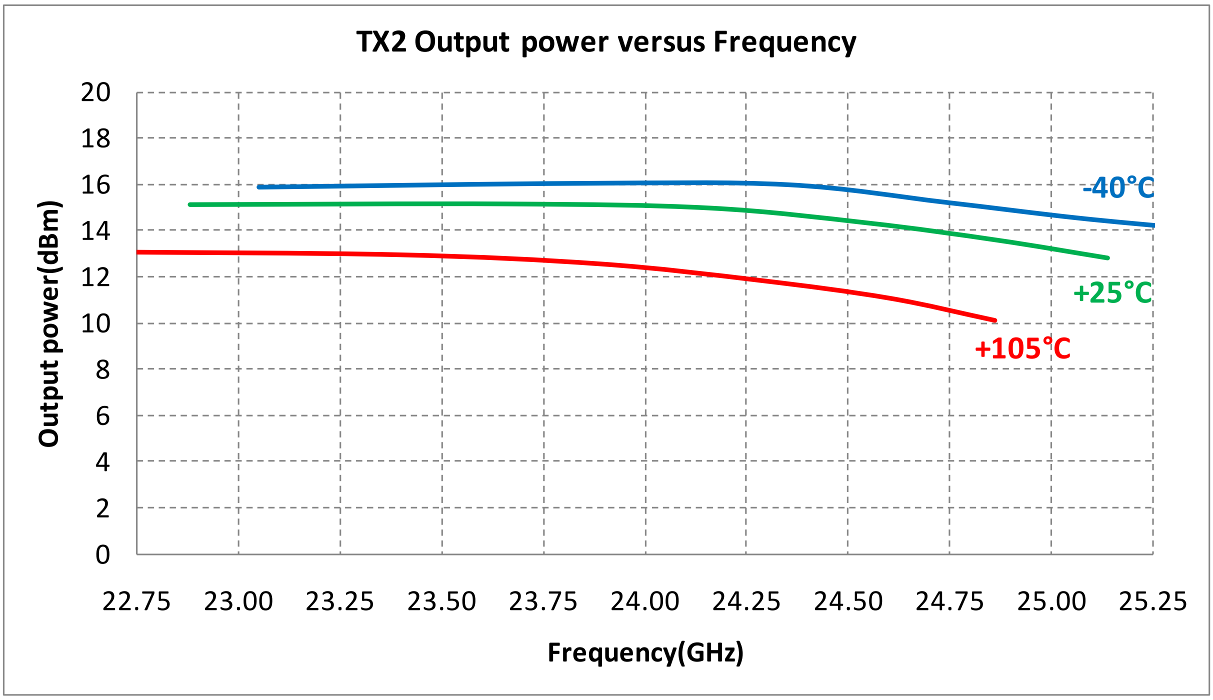
## Typical Board Measurements (QFN plan)

All supplies= +5V

### Typical Output power on TX1 versus frequency and over temperature




### Typical Output power on TX2 versus frequency and over temperature



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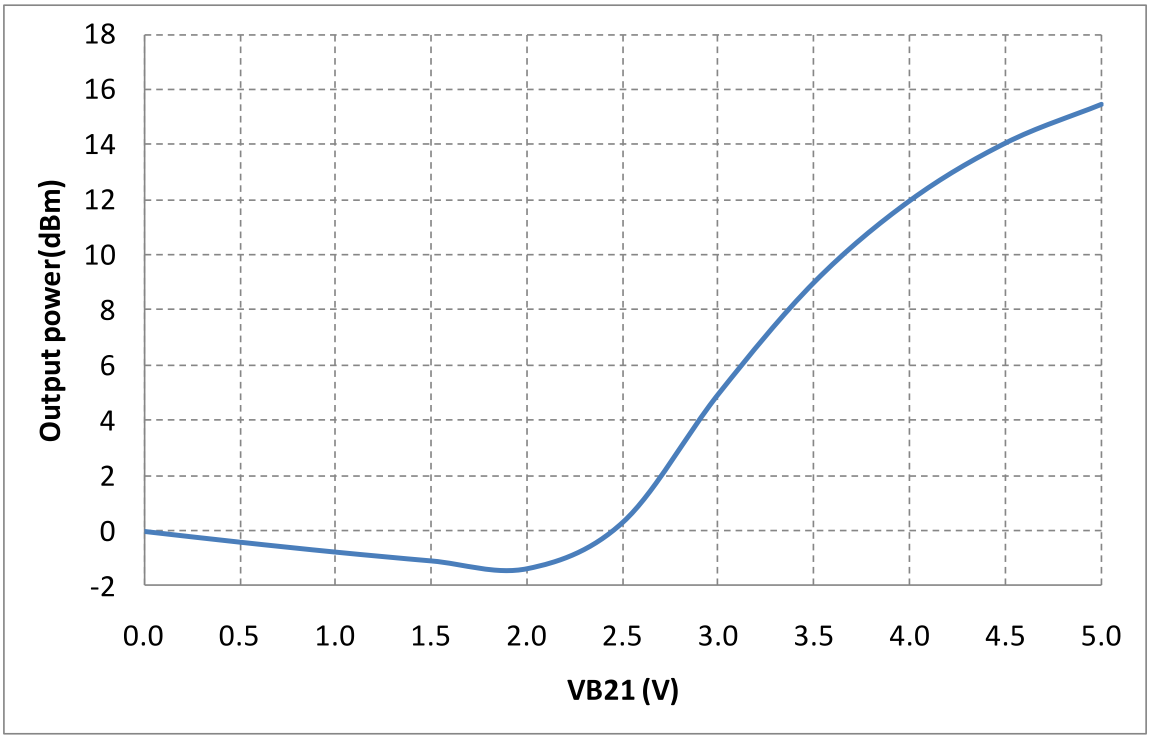
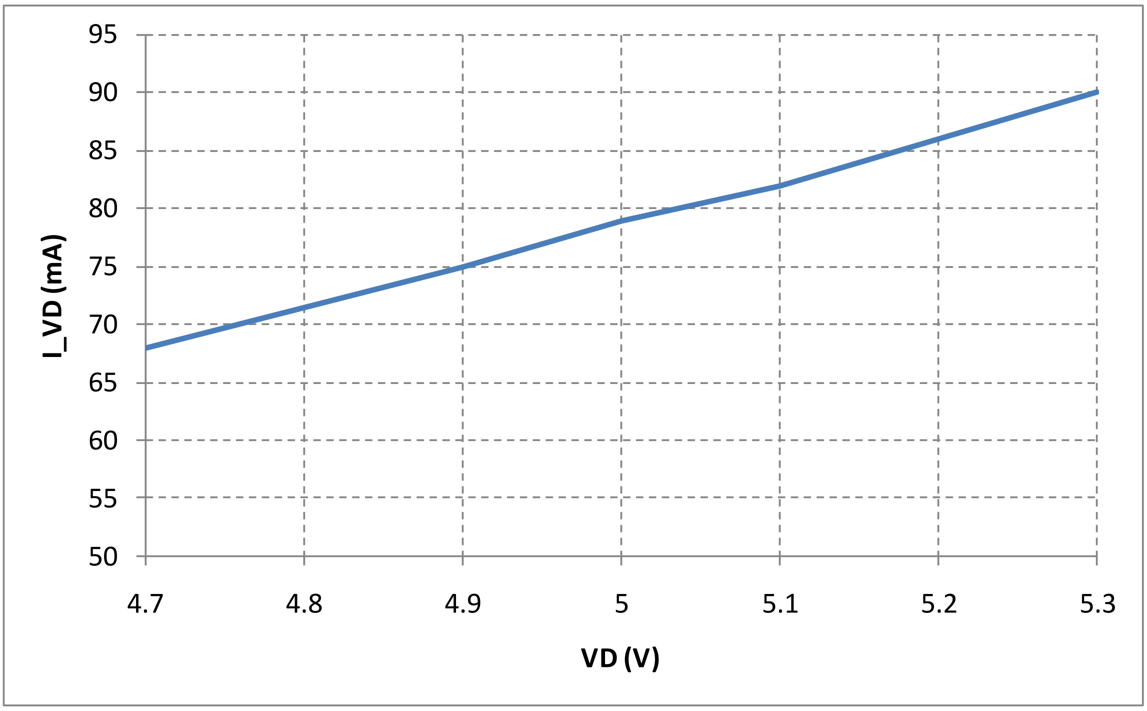
## Typical Board Measurements (QFN plan)

All supplies= +5V

**Typical TX1 Output Power versus VB21**




**Prescaler Current versus Supply Voltage**



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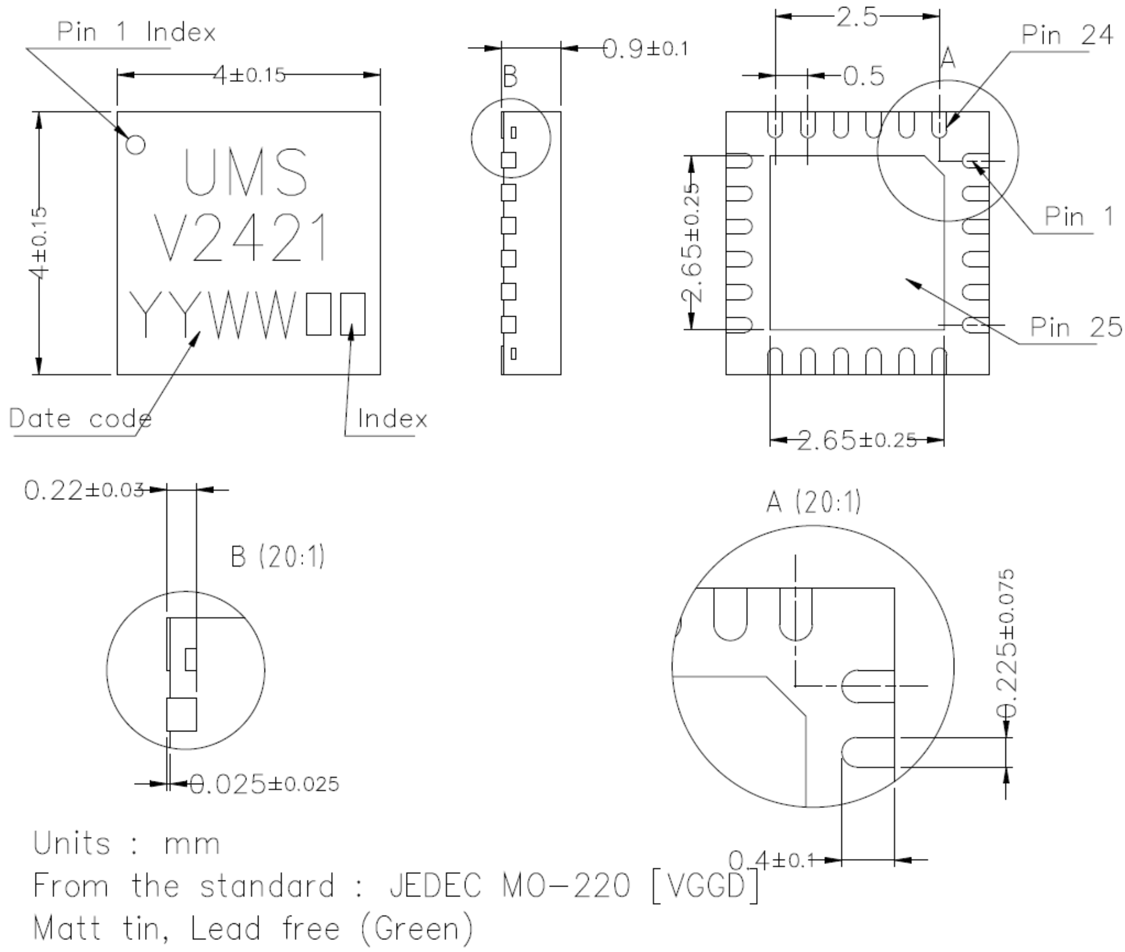
## Package outline (1)




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Matt tin, Lead Free | (Green) | 1- | P | 9- | Nc | 17- | Nc |
| Units : | mm | 2- | Nc | 10- | Gnd(2) | 18- | VB21 |
| From the standard : | JEDEC | 3- | VB | 11- | TX2 | 19- | Gnd(2) |
| | MO-220 | 4- | Nc | 12- | Gnd(2) | 20- | TX1 |
| | (VGGD) | 5- | VT | 13- | Nc | 21- | Gnd(2) |
| 25- | GND | 6- | NC | 14- | M2 | 22- | M1 |
| | | 7- | VCC | 15- | VB22 | 23- | VB11 |
| | | 8- | V1 | 16- | VB12 | 24- | VD |

(1) The package outline drawing included to this data-sheet is given for indication. Refer to the application note AN0017 (http://www.ums-gaas.com) for exact package dimensions.
(2) It is strongly recommended to ground all pins marked "Gnd" through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.



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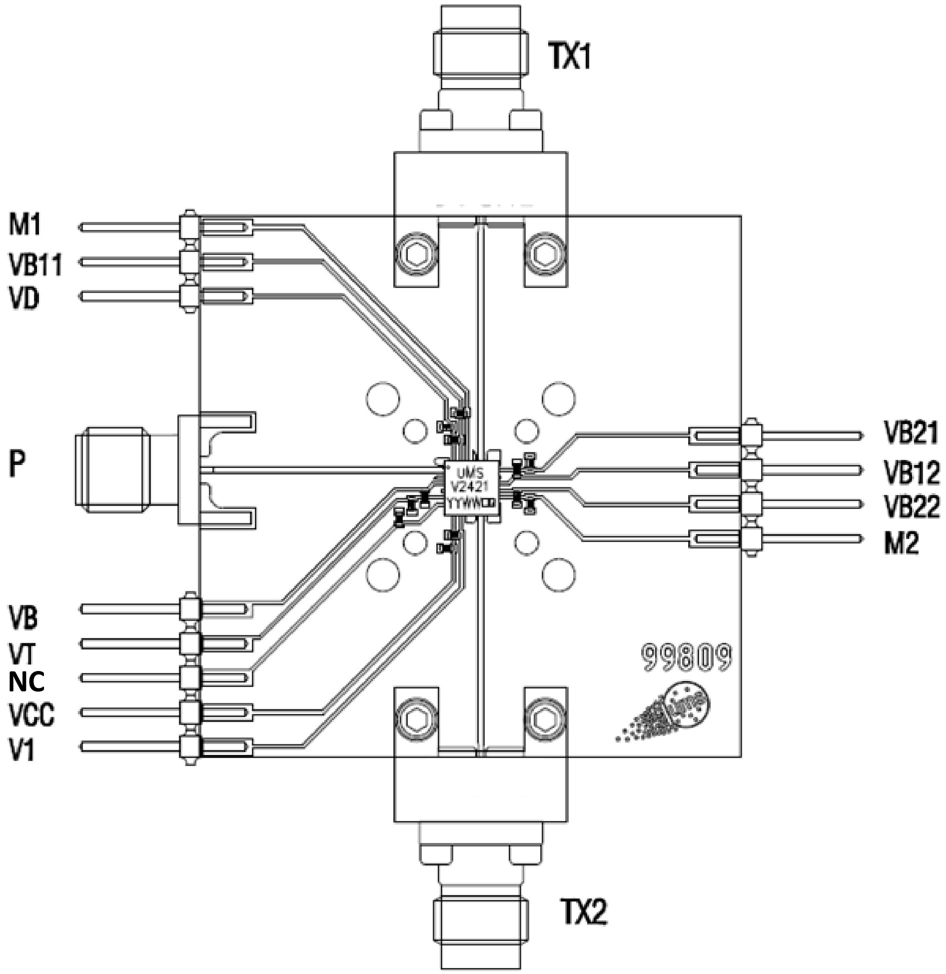
## Evaluation mother board

- Compatible with the proposed footprint.
- Based on typically Ro4003 / 8mils or equivalent.
- Using a micro-strip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.
- Decoupling capacitors of 10nF ±10% are recommended for all DC accesses.
- See application note AN0017 for details.



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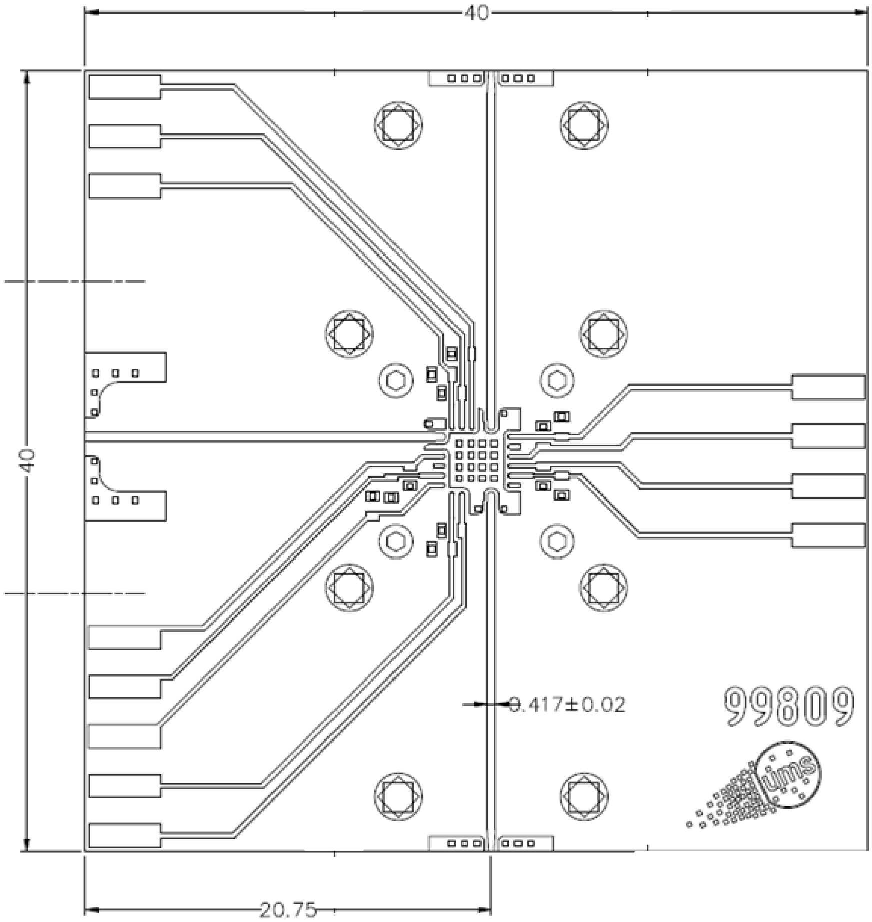
## Recommended Test Fixture PCB layout (Ref. 99809)




**MATERIAL**
Ro4003 ROGERS
Thickness: 0.008In (0,203mm)
2 sides Cu 17,5µm

**FINISH**
Front side: electroless Au 0.08 – 0.1µm over electroless Ni 5µm
Back side: electroless Au 0.08 – 0.1µm over electroless Ni 5µm

**Via holes**
- □ 54 Ø0.2 Finish
- ○ 4 Ø1 Finish
- ○ 8 Ø2 Finish



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## Recommended package footprint

Refer to the application note AN0017 available at http://www.ums-gaas.com for package foot print recommendations.

## SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017.

## Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at http://www.ums-gaas.com.

## 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 package products.

## Ordering Information

| | | |
|---|---|---|
| QFN 4x4 RoHS compliant package: | CHV2421-QDG/XY | |
| | Stick: XY = 20 | Tape & reel: XY = 21 |





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