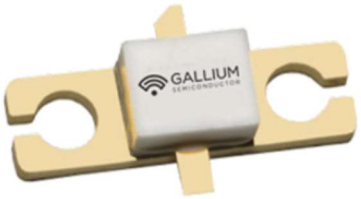
# GTH0-0007030S 50V, DC – 7.0GHz, 30W GaN HEMT

## FEATURES

- Operating Frequency Range: DC to 7.0GHz
- Operating Drain Voltage: 28V & 50V
- Maximum Output Power ($P_{SAT}$): 30W
- Air Cavity Ceramic package
- Suitable for CW, Pulsed, Linear applications
- 100% DC & RF Production Tested



NI-200 Ceramic Package

## DESCRIPTION

The GTH0-0007030S is a 30W (P3dB) unmatched discrete GaN-on-SiC HEMT which operates from DC to 7.0GHz on a 50V supply rail. The wide bandwidth of the GTH0-0007030S makes it suitable for a variety of applications including cellular infrastructure, radar, communications, and test instrumentation, and can support CW, linear and pulse operations.

The device is housed in an industry-standard NI-200 Air Cavity Ceramic package. Lead-free and RoHS compliant.

**Typical Performances** 1 Tone pulsed CW (10% duty cycle, 100µs width), 2nd Harmonics NOT optimized

(1) Optimum Peak Power at 2.5dB in compression

(2) Optimum Peak Efficiency at 2.5dB in compression

### Vds=50V, Idq= 30 mA, $T_A$ = 25°C

| Frequency (MHz) | Pout(1) (dBm) | Gain(2) (dB) | Eff(2) (%) |
|---|---|---|---|
| **2000** | 45.5 | 20.8 | 65.2 |
| **2500** | 45.4 | 18.4 | 61.7 |
| **3000** | 45.4 | 17.6 | 66.5 |
| **3500** | 45.5 | 16.4 | 67.5 |
| **4000** | 45.5 | 15.7 | 67.6 |
| **4500** | 45.5 | 15.4 | 67 |
| **5000** | 45.7 | 14.9 | 68.4 |

### Vds=28V, Idq= 30 mA, $T_A$ = 25°C

| Frequency (MHz) | Pout(1) (dBm) | Gain(2) (dB) | Eff(2) (%) |
|---|---|---|---|
| **2000** | 43 | 18.5 | 67 |
| **2500** | 42.9 | 16.9 | 67.1 |
| **3000** | 42.9 | 15.8 | 69.6 |
| **3500** | 43 | 14.5 | 69.8 |
| **4000** | 43 | 13.6 | 69.5 |
| **4500** | 43 | 12.6 | 69.3 |
| **5000** | 43.1 | 12.5 | 69.7 |

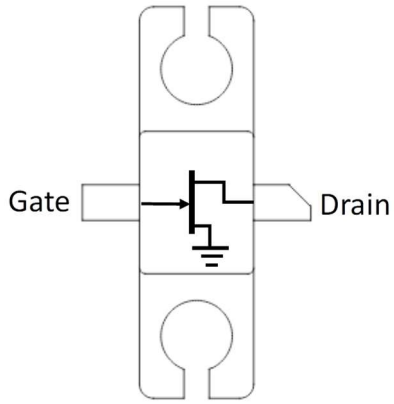
# GTH0-0007030S 50V, DC – 7.0GHz, 30W GaN HEMT

## ABSOLUTE MAXIMUM RATINGS(1, 2)

| Parameter | Rating | Symbols and Units |
|---|---|---|
| Drain Source Voltage | 150 | $V_{DS}$ (V) |
| Gate Source Voltage | -8 to +2 | $V_{GS}$ (V) |
| Operating Voltage | 55 | $V_{dsq}$ (V) |
| Junction Temperature | +225 | $T_{JUNC}$(°C) |
| Storage Temperature | -65 to +150 | $T_{STORAGE}$(°C) |
| Case Operating Temperature | -40 to +105 | $T_{CASE}$(°C) |

1. Exceeding any of these limits may cause permanent damage to this device or seriously limit the life time (MTTF)
2. GalliumSemi does not recommend sustained operation above maximum operating conditions.

## BLOCK DIAGRAM




## ELECTRICAL SPECIFICATIONS: $T_A$ = 25°C

| Parameter | Min. | Typ. | Max. | Symbols and Units | Test conditions |
|---|---|---|---|---|---|
| Frequency Range | DC | | 7000 | MHz | |
| **DC Characteristics** | | | | | |
| Drain Source Breakdown Voltage | 150 | | | $V_{BDSS}$ (V) | |
| Drain Source Leakage Current | | | | $I_{DLK}$ (mA) | Vgs = -8V, Vds = 50V |
| Gate Source Leakage Current | | | | $I_{GLK}$ (mA) | Vgs = -8V, Vds = 50V |
| Gate Threshold Voltage | -3.4 | | -1.5 | $V_{GS}$ (V) | Vds = 50V |
| **Operating Conditions** | | | | | |
| Gate Bias Voltage | | -2.5 | | $V_{GSQ}$ (V) | |
| Drain Voltage | | 50 | | $V_{DSQ}$ (V) | |
| Quiescent Drain Current | | 30 | | $I_{DQ}$ (mA) | |

## RF ELECTRICAL SPECIFICATIONS: $T_A$ = 25°C, VDS = 50 V, IDQ = 30 mA, Freq= 3600MHz
## Note: Performance(1) in GalliumSemi Production Test Fixture, 50 Ω system

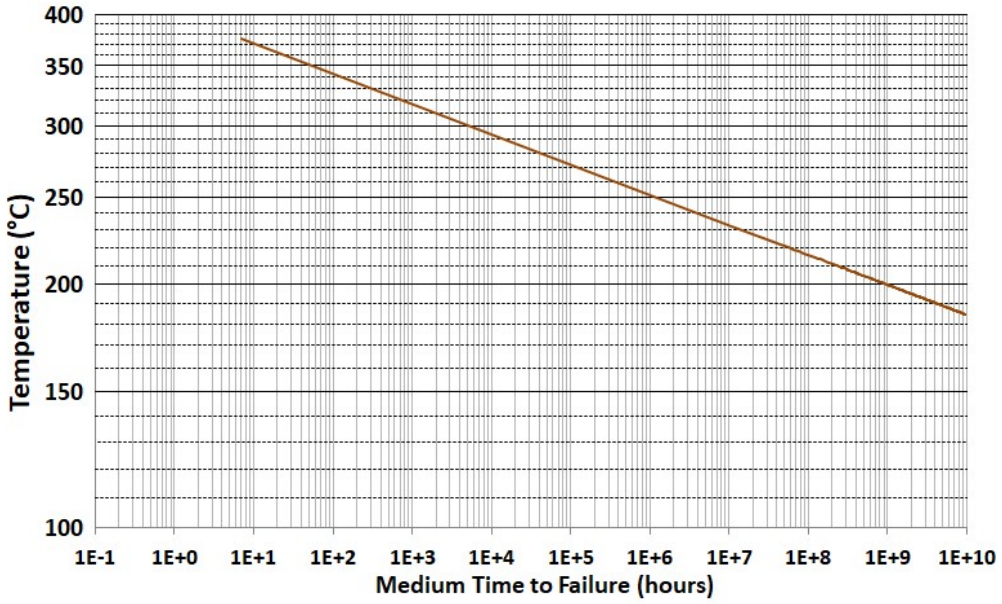
| Parameter | Symbol | Min. | Typ. | Max. | Units | Notes |
|---|---|---|---|---|---|---|
| Small Signal Gain | $G_{ss}$ | | tbd | | dB | |
| Power Gain | $G_{SAT}$ | | tbd | | dB | |
| Saturated Drain Efficiency | $DEff_{SAT}$ | | tbd | | % | |
| Saturated Output Power | $P_{SAT}$ | | tbd | | dBm | |
| Ruggedness Output mismatch | Ψ | VSWR = 10:1, all angles | | | | No damage or shift in performances |

1. 1 Tone Pulse CW, pulse width 100us, duty cycle 10%

## THERMAL AND RELABILITY INFORMATION -CW [1, 2, 3]: $T_c$ = 85°C

| Parameter | Test condition | Value | Units | Notes |
|---|---|---|---|---|
| | | | | |
| Channel Temperature, Tch | Pdiss 6 W | 135 | °C | |
| Rth | | 8.3 | ºC/W | |
| MTTF | | >1.0E10 | Hrs | |
| | | | | |
| Channel Temperature, Tch | Pdiss 12 W | 192 | °C | |
| Rth | | 9.0 | ºC/W | |
| MTTF | | 3.2E9 | Hrs | |
| | | | | |
| Channel Temperature, Tch | Pdiss 18 W | 258 | °C | |
| Rth | | 9.6 | ºC/W | |
| MTTF | | 5.0E5 | Hrs | |

1.Using 5um thermal grease - 4W/m-K.
2.Thermal Resistance using Finite Element Analysis (FEA) simulation, calibrated with Infrared measurement on surface temperature.
3.Rth vs Dissipated Power can be generalized with the following equation: Rth(ºC/W) = 0.1065 x Pdiss(W) + 7.8704

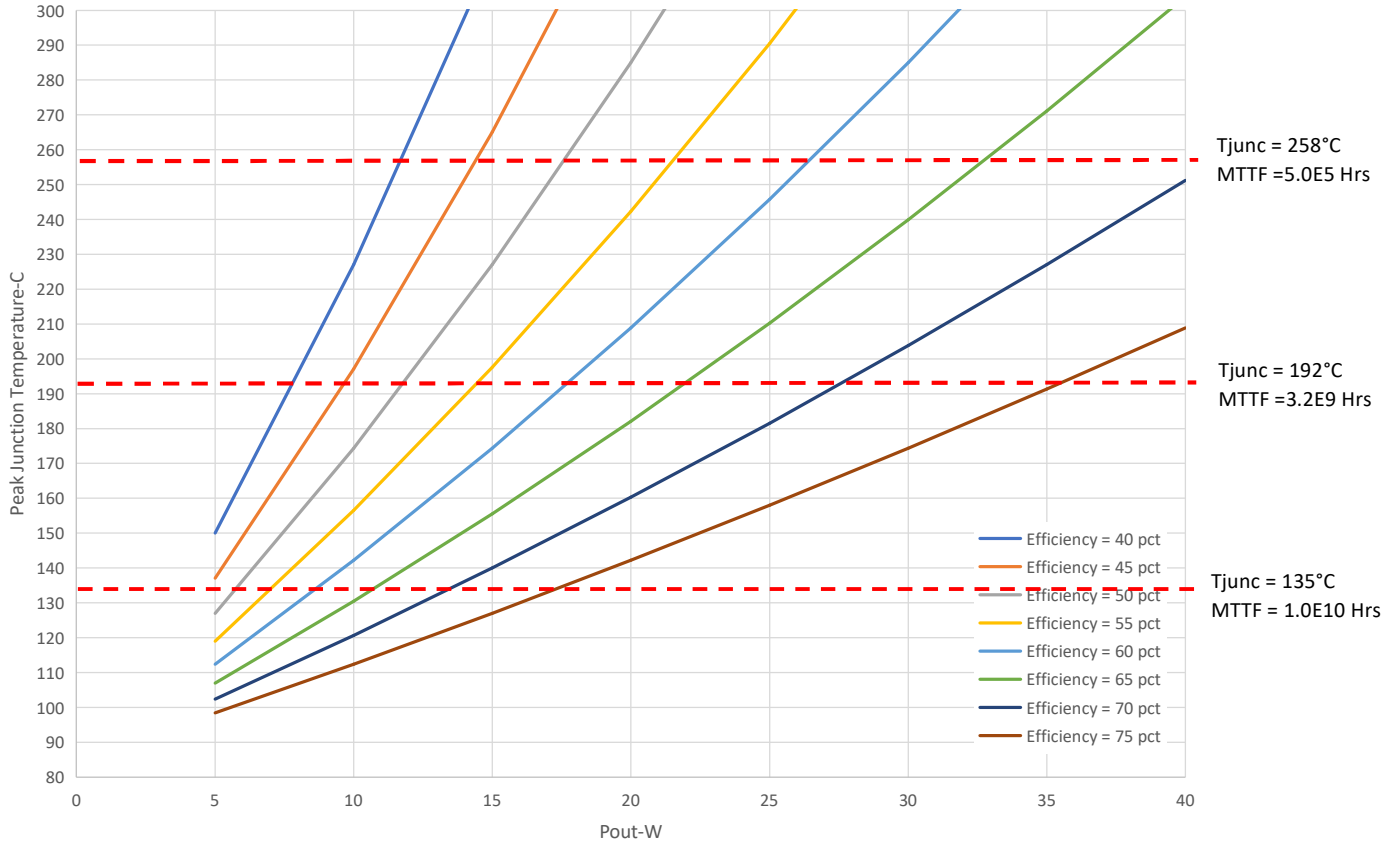


## CW OPERATION

The device can withstand CW operation with respect to the application's MTTF ( Life time vs. Peak Junction Temperature).

The graph(1,2) below shows the Peak Junction Temperature vs. the Output Power & Efficiency trade-off, using the following equations:
- Tjunc(ºC) = Pdiss(w) x Rth(ºC/W)
- Pdiss(W) = (Pout(w)/ Efficiency(%)) - Pout(w)

E.g.: The device can be used for Pout = 22W CW with Efficiency of 55%, Tjunc will be 258ºC, leading to a LifeTime ( MTTF) of 5.0E5 Hrs.




Notes:
5um thermal grease - 4W/m-K
Back of pkg is 85°C infinite heat sink

## LOADPULL MEASUREMENT, Vds= 50V Idq = 30 mA

1 Tone Pulse CW, pulse width 100us, duty cycle 10%

**For Optimum Peak Power @ 2.5dB Compression**

| Freq-MHz | Zin_F0 | Zl_F0 | Gain-dB | Pout-dBm | Pout-W | Eff-% | AMPM-deg |
|---|---|---|---|---|---|---|---|
| 2000 | 3.3 j -3.4 | 18.0 j 10.5 | 19.3 | 45.5 | 35.8 | 57.7 | 0.9 |
| 2500 | 3.2 j 1.8 | 16.6 j 9.1 | 17.5 | 45.4 | 34.7 | 56.1 | 0.2 |
| 3000 | 3.9 j 6.2 | 15.2 j 4.2 | 15.4 | 45.4 | 34.4 | 53.7 | 0.3 |
| 3500 | 3.9 j 10.4 | 12.7 j 3.6 | 14.8 | 45.5 | 35.6 | 57.6 | -1.4 |
| 4000 | 4.3 j 14.3 | 12.3 j 0.3 | 13.6 | 45.5 | 35.4 | 55.8 | -1.2 |
| 4500 | 5.0 j 20.5 | 10.1 j -1.7 | 13.3 | 45.5 | 35.9 | 58.8 | -1.6 |
| 5000 | 5.8 j 28.5 | 8.7 j -3.9 | 13.1 | 45.7 | 37.1 | 62.6 | -1.5 |

**For Optimum Peak Efficiency @ 2.5dB Compression**

| Freq-MHz | Zin_F0 | Zl_F0 | Gain-dB | Pout-dBm | Pout-W | Eff-% | AMPM-deg |
|---|---|---|---|---|---|---|---|
| 2000 | 2.2 j -1.3 | 14.2 j 22.6 | 20.8 | 43.8 | 24 | 65.2 | 0.7 |
| 2500 | 2.4 j 2.7 | 14.1 j 19.4 | 18.4 | 44.3 | 27.1 | 61.7 | 1 |
| 3000 | 2.2 j 7.8 | 8.7 j 13.6 | 17.6 | 44 | 25.2 | 66.5 | -2.7 |
| 3500 | 2.7 j 11.0 | 7.0 j 9.0 | 16.4 | 44.1 | 26 | 67.5 | -4.4 |
| 4000 | 3.0 j 15.6 | 6.0 j 5.4 | 15.7 | 44.1 | 25.5 | 67.6 | -4.4 |
| 4500 | 3.1 j 21.4 | 5.1 j 2.2 | 15.4 | 43.8 | 23.9 | 67 | -4.2 |
| 5000 | 4.0 j 29.9 | 5.3 j -0.9 | 14.9 | 44.3 | 27.2 | 68.4 | -2.8 |

## LOADPULL MEASUREMENT, Vds= 28V Idq = 30 mA

1 Tone Pulse CW, pulse width 100us, duty cycle 10%

**For Optimum Peak Power @ 2.5dB Compression**

| Freq-MHz | Zin_F0 | Zl_F0 | Gain-dB | Pout-dBm | Pout-W | Eff-% | AMPM-deg |
|---|---|---|---|---|---|---|---|
| 2000 | 3.0 j -3.0 | 15.2 j 3.1 | 17.5 | 43 | 20.3 | 60.7 | 1.2 |
| 2500 | 3.5 j 2.1 | 16.8 j -0.4 | 15.2 | 42.9 | 19.4 | 58 | 0.9 |
| 3000 | 2.9 j 7.3 | 12.3 j 1.3 | 14.7 | 42.9 | 19.7 | 64.6 | -1.8 |
| 3500 | 3.8 j 11.2 | 10.8 j -3.1 | 13 | 43 | 20 | 60.2 | -2.1 |
| 4000 | 4.3 j 15.9 | 11.3 j -5.2 | 12.3 | 43 | 19.8 | 60.5 | -2.9 |
| 4500 | 5.0 j 22.0 | 11.2 j -7.3 | 11.5 | 43 | 20.1 | 60.9 | -2.8 |
| 5000 | 6.1 j 30.9 | 10.7 j -9.2 | 11.4 | 43.1 | 20.5 | 63.2 | -3.2 |

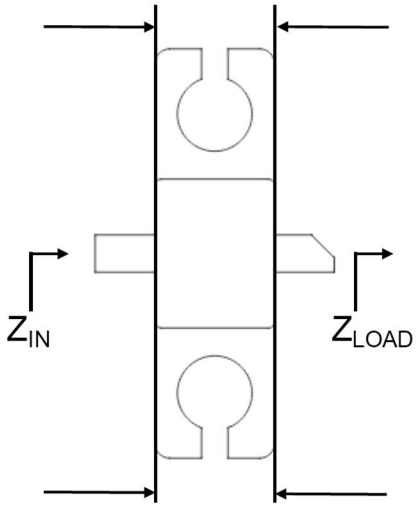
**For Optimum Peak Efficiency @ 2.5dB Compression**

| Freq-MHz | Zin_F0 | Zl_F0 | Gain-dB | Pout-dBm | Pout-W | Eff-% | AMPM-deg |
|---|---|---|---|---|---|---|---|
| 2000 | 2.3 j -1.7 | 16.1 j 14.8 | 18.5 | 41.3 | 13.5 | 67 | 1.6 |
| 2500 | 2.5 j 2.8 | 13.3 j 9.0 | 16.9 | 42.1 | 16.3 | 67.1 | -1.4 |
| 3000 | 2.2 j 8.7 | 9.5 j 7.9 | 15.8 | 41.3 | 13.4 | 69.6 | -3.8 |
| 3500 | 2.6 j 11.9 | 7.8 j 4.0 | 14.5 | 41.4 | 13.8 | 69.8 | -5.5 |
| 4000 | 2.9 j 16.7 | 7.2 j 0.9 | 13.6 | 41.4 | 13.8 | 69.5 | -5.7 |
| 4500 | 3.8 j 22.3 | 6.3 j -2.6 | 12.6 | 41.5 | 14.2 | 69.3 | -7.2 |
| 5000 | 4.6 j 31.0 | 5.2 j -6.0 | 12.5 | 41.2 | 13.3 | 69.7 | -7.7 |

## LOADPULL MEASUREMENT NOTES

Source and Load impedance @ 2nd Harmonic are set to 10 Ohms
With proper 2nd Harmonic termination, expect +5% Efficiency for Source and similar with Drain 2nd Harmonic.
$Z_{LOAD}$: Measured Impedance presented to the output of the device in the reference plane
$Z_{IN}$: Measured input Impedance at the input of the device in the reference plane

**Impedance Reference Plane**

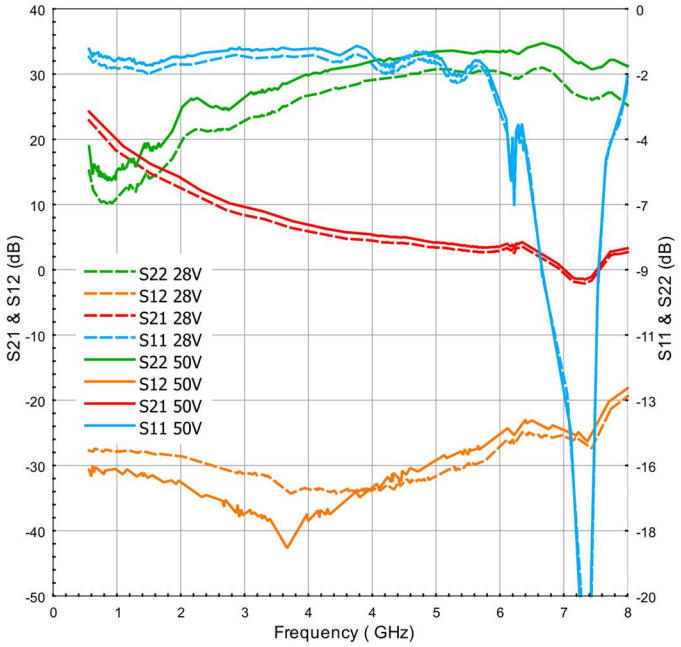



Raw data and full Loadpull measurement report available at request: sales@galliumsemi.com

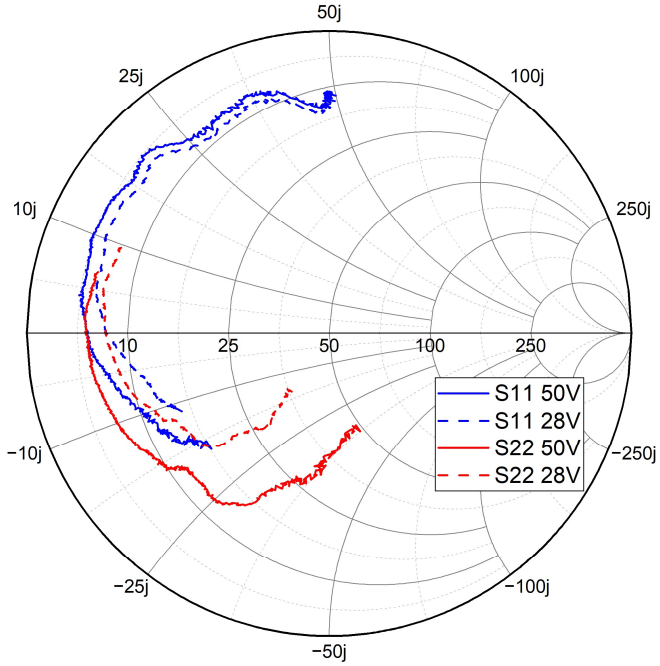
## BROADBAND S-PARAMETERS MEASUREMENT, Vds= 28 & 50V Idq = 30 mA

1 Tone CW

### S Parameters (Mag-dB)



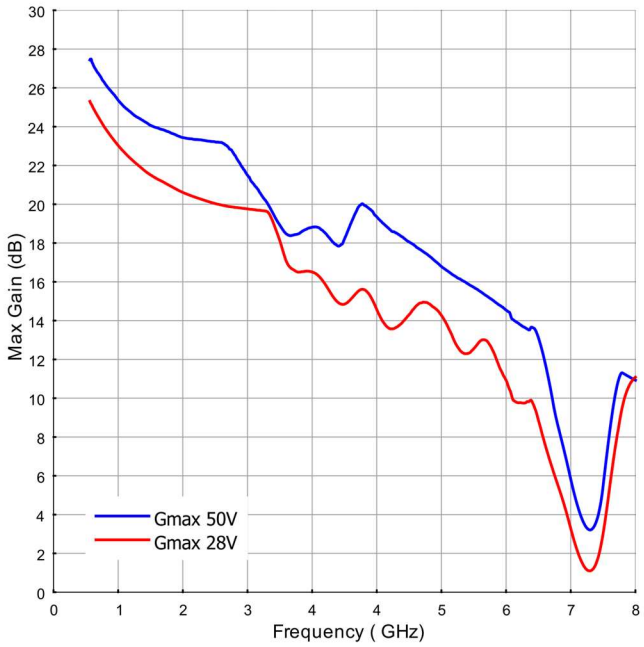

### S11 & S22 0.4-8 GHz



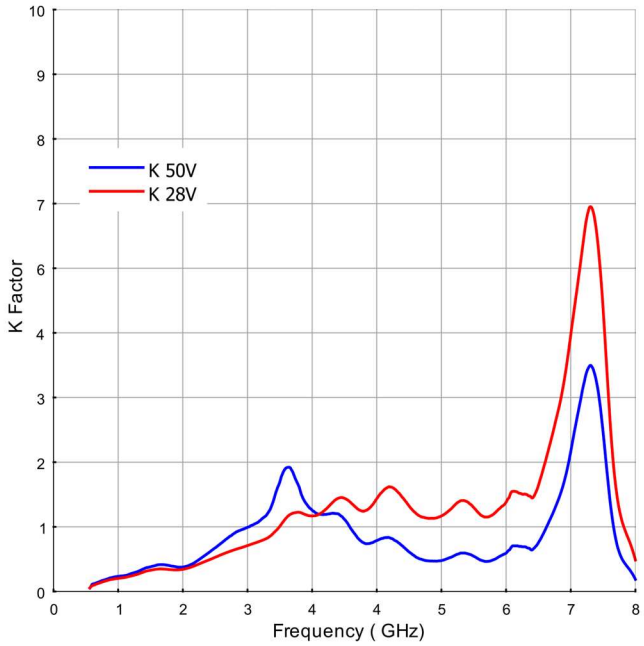
## BROADBAND S-PARAMETERS MEASUREMENT, Vds= 28 & 50V Idq = 30 mA

1 Tone CW

### Maximum Available Gain




### K Factor



## GaN HEMT BIASING SEQUENCE

**To turn the transistor ON**

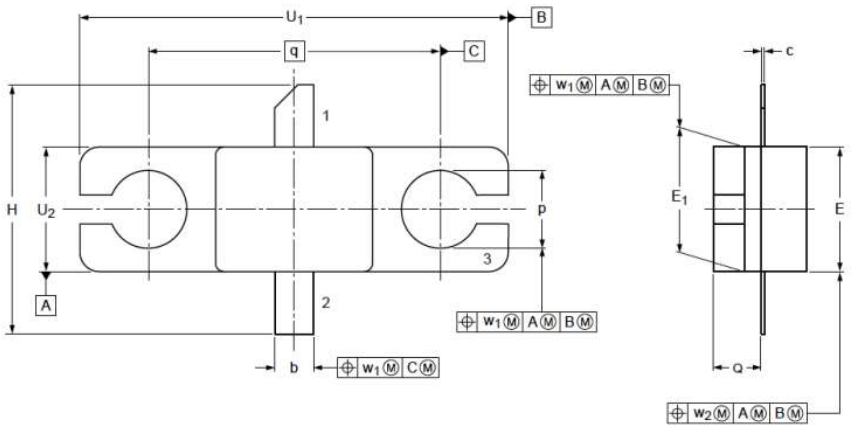
1. Set $V_{GS}$ to -5V
2. Turn on $V_{DS}$ to normal operation voltage (50V)
3. Slowly increase $V_{GS}$ to set $I_{DQ}$ current (30 mA)
4. Apply RF power

**To turn the transistor OFF**

1. Turn the RF power off
2. Decrease $V_{GS}$ to -5V
3. Turn off $V_{D.}$ Wait a few seconds for drain capacitor to discharge
4. Turn off $V_{GS}$

**GTH0-0007030S** **50V, DC – 7.0GHz, 30W GaN HEMT**

## PACKAGE DIMENSIONS




Dimensions

| Unit(1) | | A | b | c | D | $D_1$ | E | $E_1$ | F | H | p | Q | q | $U_1$ | $U_2$ | $w_1$ | $w_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 3.68 | 1.40 | 0.15 | 5.18 | 5.21 | 4.17 | 4.19 | 1.14 | 8.64 | 2.67 | 1.70 | | 14.10 | 4.19 | | |
| | nom | | | | | | | | | | | | 9.53 | | | 0.25 | 0.380 |
| | min | 2.84 | 1.14 | 0.08 | 4.98 | 4.95 | 3.96 | 3.94 | 0.89 | 7.62 | 2.41 | 1.45 | | 13.84 | 3.94 | | |
| inches | max | 0.145 | 0.055 | 0.006 | 0.204 | 0.205 | 0.164 | 0.165 | 0.045 | 0.340 | 0.105 | 0.067 | | 0.555 | 0.165 | | |
| | nom | | | | | | | | | | | | 0.375 | | | 0.01 | 0.015 |
| | min | 0.112 | 0.045 | 0.003 | 0.196 | 0.195 | 0.156 | 0.155 | 0.035 | 0.300 | 0.095 | 0.057 | | 0.545 | 0.155 | | |

Note
1. Millimeter dimensions are derived from the original inch dimensions.

## PIN CONFIGURATION

| Pin | Input/Output |
|---|---|
| 1 | RF Output / Drain Voltage |
| 2 | RF Input / Gate Voltage |
| 3 (flange) | Ground |

## DEVICE LABEL

| | | |
|---|---|---|
| Line 1: | COMPANY NAME: | GALLIUM |
| Line 2: | PART NUMBER - WAFER # | |
| Line 3: | AA: | Assembly Code |
| | YYWW: | Assembly Date Code |
| | R: | Reserved code |

## HANDLING PRECAUTIONS

| Parameter | Symbol | Class | Test Methodology |
|---|---|---|---|
| ESD – Human Body Model | HBM | Class 1A (250 V) | ANSI/ESDA/JEDEC Standard JS-001 |
| ESD – Charged Device Model | CDM | Class C3 (1500 V) | ANSI/ESDA/JEDEC Standard JS-002 |
| MSL – Moisture Sensitivity Level | MSL | MSL 1 | IPC/JEDEC Standard J-STD-020 |


## RoHS COMPLIANCE

Gallium Semiconductor's Policy on EU RoHS available online:
https://www.galliumsemi.com/_files/ugd/3748d3_1107b9788f9845f78f45d424097c4c97.pdf

## CONTACT INFORMATION

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