



GaN-HEMT 210W

EGN21C210I2D

High Voltage - High Power GaN-HEMT

FEATURES

- High Voltage Operation : $V_{DS}=50V$
- High Power : 53.0dBm (typ.) @ P_{sat}
- High Efficiency: 68%(typ.) @ P_{sat}
- Power Gain : 18dB(typ.) @ $f=2.14GHz$
- Proven Reliability



DESCRIPTION

SEDI's GaN-HEMT offers high efficiency, ease of matching, greater consistency and broad bandwidth for high power L-band amplifiers with 50V operation, and gives you higher gain.

This new product is ideally suited for use in 2.14GHz W-CDMA & LTE design requirements as it offers high gain, long term reliability and ease of use.

ABSOLUTE MAXIMUM RATINGS (Case Temperature $T_c=25^\circ C$)

| Item | Symbol | Condition | Rating | Unit |
|-------------------------|-----------|--------------|-------------|------------|
| Operating-Voltage | V_{DS} | | 55 | V |
| Drain-Source Voltage | V_{DS} | $V_{GS}=-8V$ | 160 | V |
| Gate-Source Voltage | V_{GS} | | -15 | V |
| Total Power Dissipation | P_t | | 173 | W |
| Storage Temperature | T_{stg} | | -65 to +175 | $^\circ C$ |
| Channel Temperature | T_{ch} | | 250 | $^\circ C$ |

RECOMMENDED OPERATING CONDITION

| Item | Symbol | Condition | Limit | Unit |
|----------------------|-----------|---------------|-------------|------------|
| DC Input Voltage | V_{DS} | | ≤ 55 | V |
| Forward Gate Current | I_{GF} | $R_G=5\Omega$ | ≤ 204 | mA |
| Reverse Gate Current | I_{GR} | $R_G=5\Omega$ | ≥ -7.8 | mA |
| Channel Temperature | T_{ch} | | ≤ 180 | $^\circ C$ |
| Average Output Power | P_{ave} | | ≤ 50.0 | dBm |

ELECTRICAL CHARACTERISTICS (Case Temperature $T_c=25^\circ C$)

| Item | Symbol | Condition | Limit | | | Unit |
|---|--------------|-------------------------------------|-------|------|------|--------------|
| | | | min. | Typ. | Max. | |
| Pinch-Off Voltage | V_p | $V_{DS}=50V$ $I_{DS}=54.4mA$ | -1.0 | -1.5 | -2.0 | V |
| Saturated Power | $P_{sat} *1$ | $V_{DS}=50V$ | 52.2 | 53.0 | - | dBm |
| Drain Efficiency | $\eta_d *2$ | $I_{DS}(DC)=750mA$ | 28.0 | 32.0 | - | % |
| Power Gain | $G_p *2$ | | 17.0 | 18.0 | - | dB |
| 3 rd Order Inter-modulation Distortion | $IM3 *2$ | | -28 | -32 | - | dBc |
| Thermal Resistance | R_{th} | Channel to Case at 105W P_{DC} | - | 1.1 | 1.3 | $^\circ C/W$ |

*1 : 10%-duty RF pulse (DC supply constant), $f=2.14GHz$

*2 : $P_{out} = 45dBm$, $f_0=2.135GHz$, $f_1=2.145GHz$, W-CDMA(3GPP3.4 12-00) BS-1 64ch 47.5% clipping modulation (Peak/Avg.=8.5dB@0.01% Probability on CCDF).



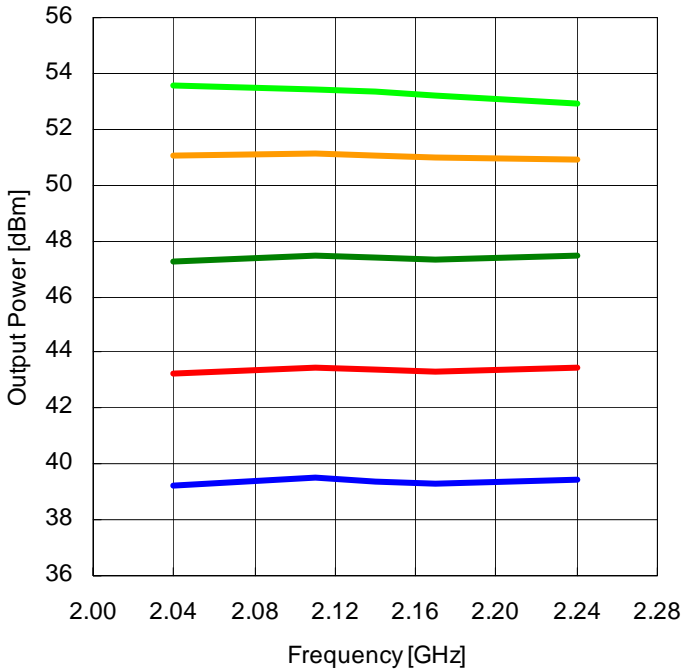
GaN-HEMT 210W

EGN21C210I2D

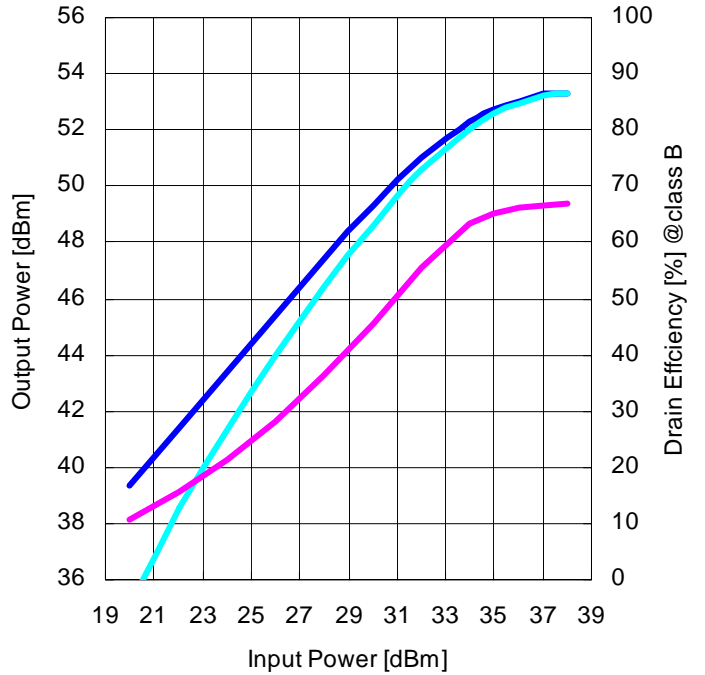
High Voltage - High Power GaN-HEMT

RF characteristics @f=2.14GHz fine tuned

Output Power vs. Frequency
V_{DS}=50V I_{DS(DC)}=750mA



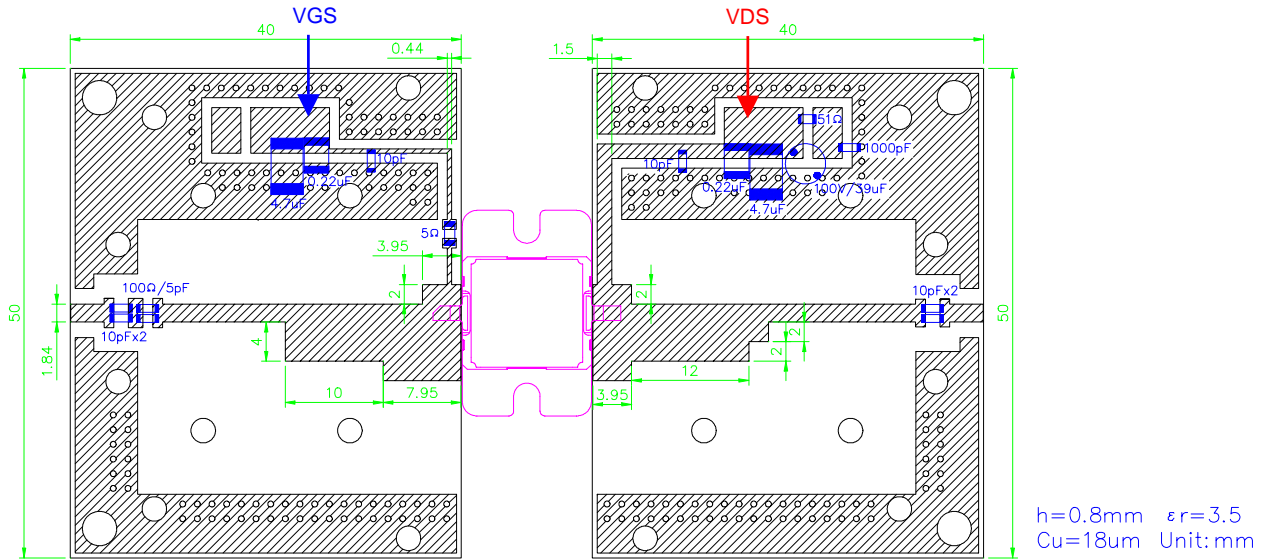
Output Power and Drain Efficiency vs. Input Power
V_{DS}=50V I_{DS(DC)}=750mA f=2.14GHz



Pin=20dBm Pin=24dBm Pin=28dBm
Pin=32dBm Pin=38dBm

Pout (class AB) Pout (class B) Nd (class B)
Pulse Signal (10%-duty, DC : constant)

Test Fixture



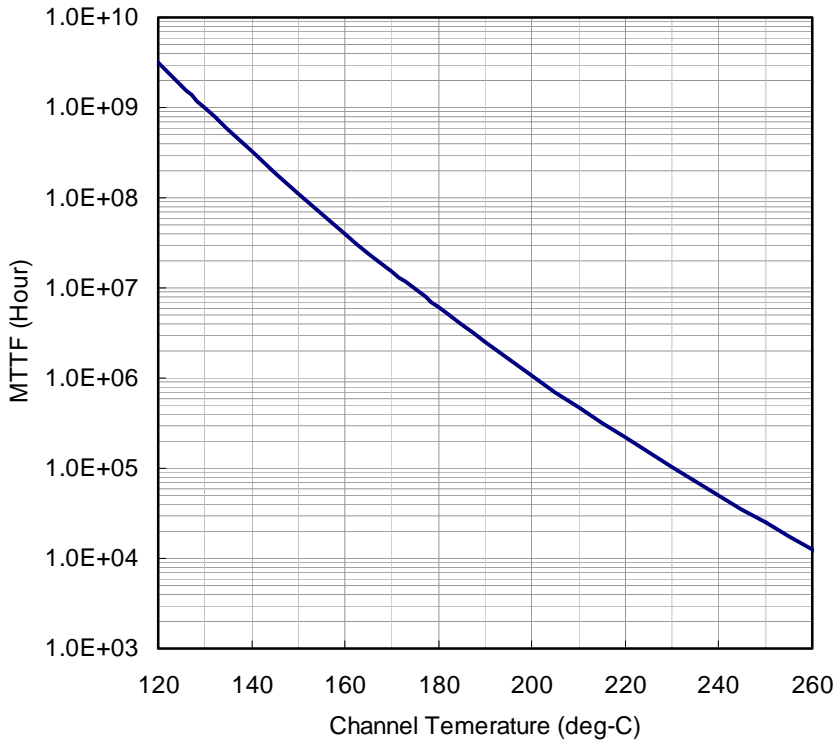


GaN-HEMT 210W

EGN21C210I2D

High Voltage - High Power GaN-HEMT

MTTF Calculation
- Estimated MTTF -



Ea=1.6eV
Confidence Level=90%

| Channel Temp (deg-C) | MTTF (Hours) |
|----------------------|------------------------|
| 160 | 4.05 x 10 ⁷ |
| 180 | 6.07 x 10 ⁶ |
| 200 | 1.07 x 10 ⁶ |

$$AF = \exp\left[-\frac{Ea}{k}\left(\frac{1}{T_{stress}} - \frac{1}{T_{use}}\right)\right]$$

$$MTTF_{use} = MTTF_{stress} * AF$$

Where;

AF: acceleration factor

Ea: activation energy (1.6 eV)

k: Boltzman's constant (8.62 x 10⁻⁵ eV/K)

T_{stress}: stress temperature (K)

T_{use}: use temperature (K)

ESD characteristic

| Test Methodology | Class |
|---------------------------------------|-------|
| Human Body Model (per JESD22-A114) | 1B |
| Machine Model (per JEI/ESD22-A115) | A |



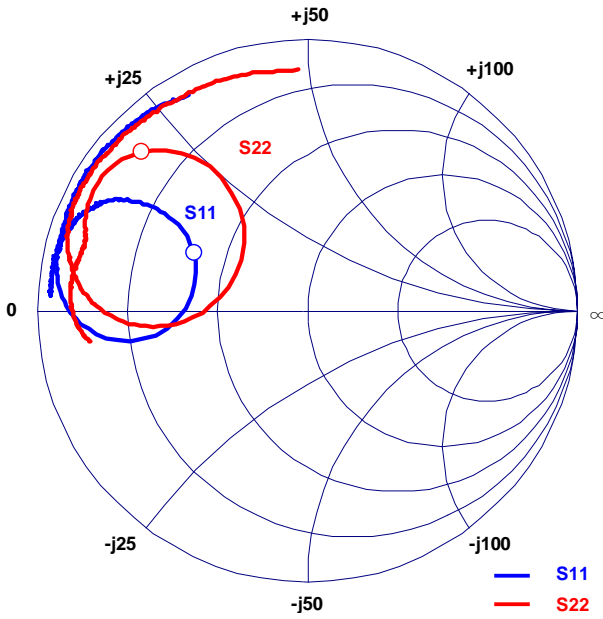
GaN-HEMT 210W

EGN21C210I2D

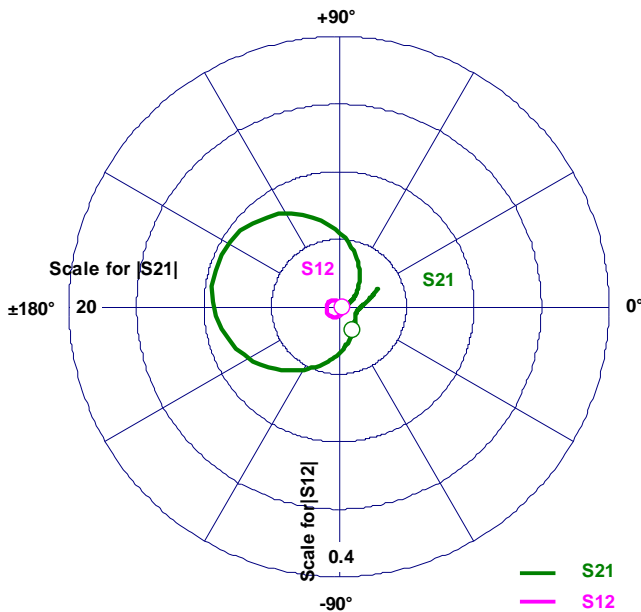
High Voltage - High Power GaN-HEMT

- Reference DATA -

S-Parameters @V_{DS}=50V, I_{DS(DC)}=750mA, f=0.5 to 4.5 GHz
Z_l = Z_s = 50 ohm Marker : 2.14GHz



| Freq. GHz | S11 | | S21 | | S12 | | S22 | |
|--------------|------|---------|------|---------|-------|---------|------|---------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 0.50 | 0.95 | 176.51 | 3.18 | 25.30 | 0.002 | -22.89 | 0.81 | -171.87 |
| 0.60 | 0.96 | 174.61 | 2.50 | 17.03 | 0.002 | -18.05 | 0.84 | -174.65 |
| 0.70 | 0.96 | 173.14 | 2.06 | 9.59 | 0.002 | -8.32 | 0.86 | -177.18 |
| 0.80 | 0.96 | 171.13 | 1.77 | 3.13 | 0.002 | -13.74 | 0.87 | -179.84 |
| 0.90 | 0.95 | 170.13 | 1.57 | -3.11 | 0.002 | -5.17 | 0.88 | 178.05 |
| 1.00 | 0.95 | 168.06 | 1.44 | -8.90 | 0.002 | 12.74 | 0.88 | 175.89 |
| 1.10 | 0.95 | 166.63 | 1.37 | -14.79 | 0.002 | 5.91 | 0.88 | 173.73 |
| 1.20 | 0.95 | 165.12 | 1.35 | -20.75 | 0.002 | 21.61 | 0.88 | 171.73 |
| 1.30 | 0.94 | 162.94 | 1.36 | -27.12 | 0.003 | 17.48 | 0.88 | 169.91 |
| 1.40 | 0.94 | 161.68 | 1.43 | -33.42 | 0.003 | 22.50 | 0.87 | 168.30 |
| 1.50 | 0.93 | 159.93 | 1.55 | -41.01 | 0.004 | 8.27 | 0.87 | 166.85 |
| 1.60 | 0.92 | 157.70 | 1.75 | -49.52 | 0.004 | 3.83 | 0.86 | 165.37 |
| 1.70 | 0.89 | 155.18 | 2.08 | -59.50 | 0.005 | -2.70 | 0.86 | 163.82 |
| 1.80 | 0.86 | 153.03 | 2.56 | -71.97 | 0.006 | -18.16 | 0.86 | 162.41 |
| 1.90 | 0.82 | 149.78 | 3.31 | -87.65 | 0.007 | -33.27 | 0.87 | 160.01 |
| 2.00 | 0.74 | 146.89 | 4.58 | -108.73 | 0.010 | -58.88 | 0.90 | 155.90 |
| 2.10 | 0.57 | 146.57 | 6.86 | -139.60 | 0.015 | -93.93 | 0.90 | 145.08 |
| 2.20 | 0.48 | -176.68 | 9.55 | 163.83 | 0.019 | -159.61 | 0.58 | 123.10 |
| 2.30 | 0.86 | -178.23 | 6.51 | 101.64 | 0.013 | 133.01 | 0.39 | -179.13 |
| 2.40 | 0.94 | 171.52 | 3.58 | 67.17 | 0.008 | 94.39 | 0.66 | -175.88 |
| 2.50 | 0.95 | 166.32 | 2.13 | 47.07 | 0.005 | 72.68 | 0.79 | 178.35 |
| 2.60 | 0.95 | 163.27 | 1.39 | 33.22 | 0.003 | 60.25 | 0.85 | 173.35 |
| 2.70 | 0.96 | 160.81 | 0.97 | 23.21 | 0.003 | 50.70 | 0.89 | 169.50 |
| 2.80 | 0.96 | 158.94 | 0.73 | 15.46 | 0.002 | 46.42 | 0.92 | 166.34 |
| 2.90 | 0.96 | 157.33 | 0.56 | 8.08 | 0.002 | 48.35 | 0.93 | 163.31 |
| 3.00 | 0.96 | 155.49 | 0.45 | 1.64 | 0.002 | 56.49 | 0.94 | 160.72 |
| 3.10 | 0.96 | 154.06 | 0.38 | -3.57 | 0.002 | 81.03 | 0.94 | 158.00 |
| 3.20 | 0.96 | 152.36 | 0.32 | -8.77 | 0.002 | 83.29 | 0.95 | 155.11 |
| 3.30 | 0.96 | 150.79 | 0.28 | -13.43 | 0.001 | 92.89 | 0.95 | 152.59 |
| 3.40 | 0.96 | 149.37 | 0.26 | -18.12 | 0.003 | 87.35 | 0.95 | 149.75 |
| 3.50 | 0.97 | 147.59 | 0.24 | -22.16 | 0.003 | 91.49 | 0.95 | 147.20 |
| 3.60 | 0.96 | 145.93 | 0.23 | -26.13 | 0.003 | 77.02 | 0.95 | 144.17 |
| 3.70 | 0.96 | 144.22 | 0.22 | -31.16 | 0.004 | 71.95 | 0.94 | 141.17 |
| 3.80 | 0.96 | 142.47 | 0.22 | -35.59 | 0.004 | 81.45 | 0.94 | 137.88 |
| 3.90 | 0.96 | 140.14 | 0.22 | -39.58 | 0.005 | 77.12 | 0.94 | 134.07 |
| 4.00 | 0.95 | 137.97 | 0.23 | -45.46 | 0.006 | 69.99 | 0.93 | 129.63 |
| 4.10 | 0.95 | 135.21 | 0.25 | -50.46 | 0.006 | 56.43 | 0.92 | 125.02 |
| 4.20 | 0.94 | 132.29 | 0.28 | -57.15 | 0.007 | 44.64 | 0.91 | 119.49 |
| 4.30 | 0.94 | 128.97 | 0.33 | -64.42 | 0.007 | 38.66 | 0.91 | 112.23 |
| 4.40 | 0.93 | 124.43 | 0.40 | -73.60 | 0.006 | 23.54 | 0.90 | 103.80 |
| 4.50 | 0.91 | 119.05 | 0.50 | -85.32 | 0.007 | 18.47 | 0.89 | 92.32 |



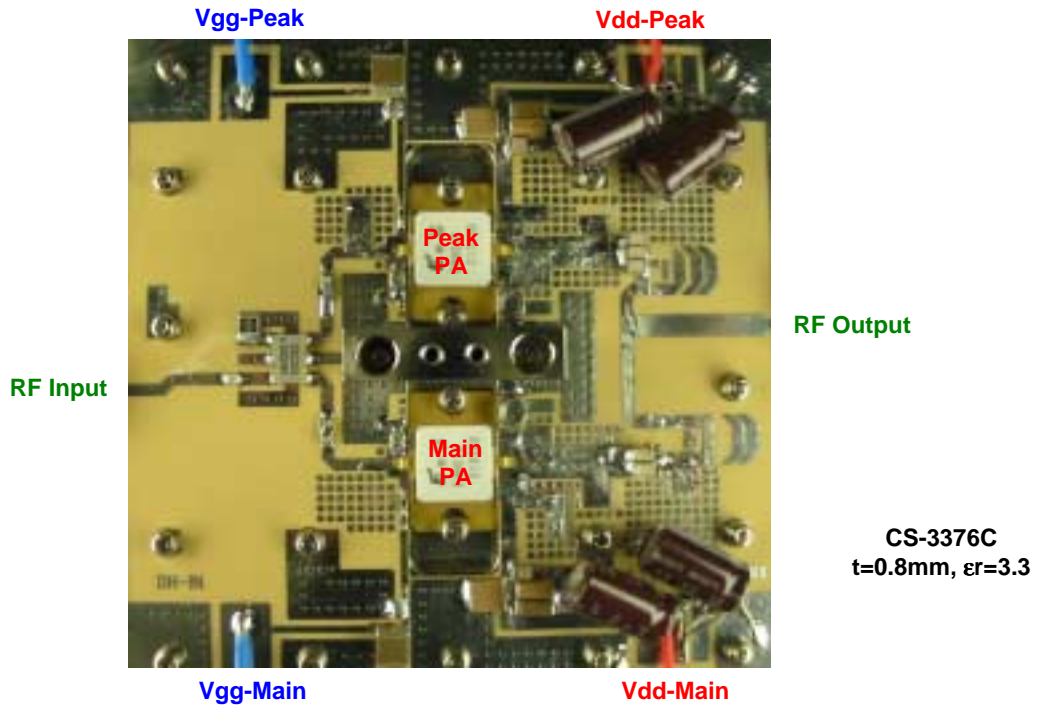


- Application DATA -

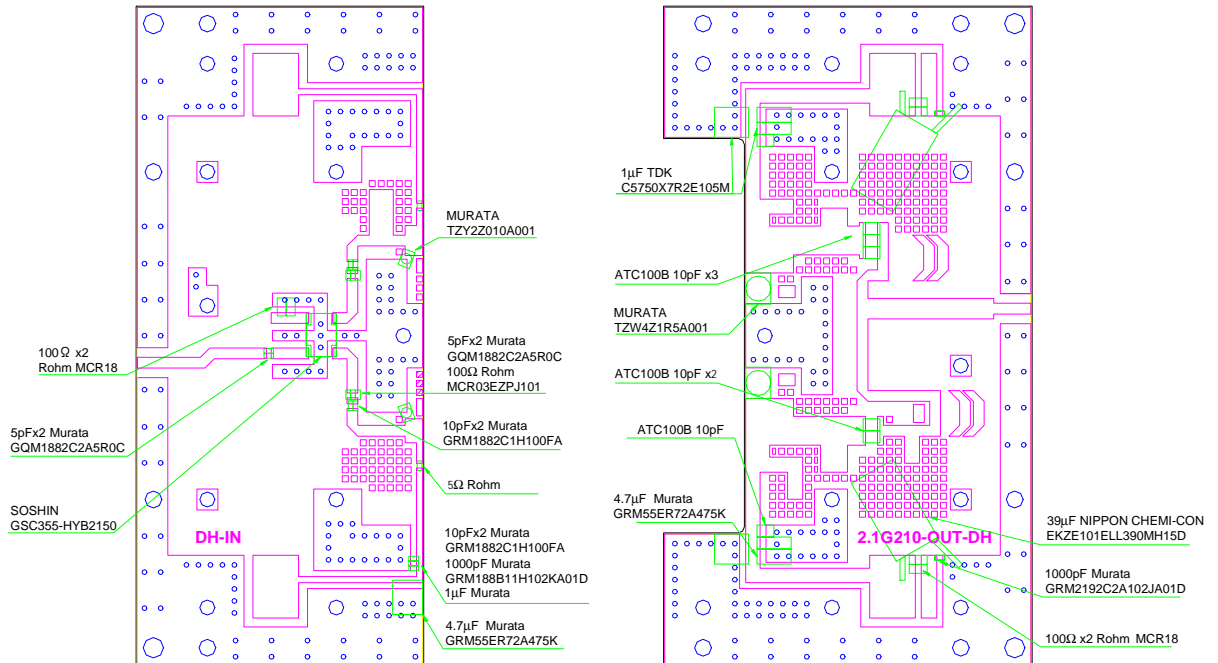
Doherty Amplifier drawing

EGN21C210I2D

High Voltage - High Power GaN-HEMT



Test Fixture



CS3376C, $t=0.8\text{mm}$, $\epsilon_r=3.5$



SUMITOMO ELECTRIC DEVICE INNOVATIONS



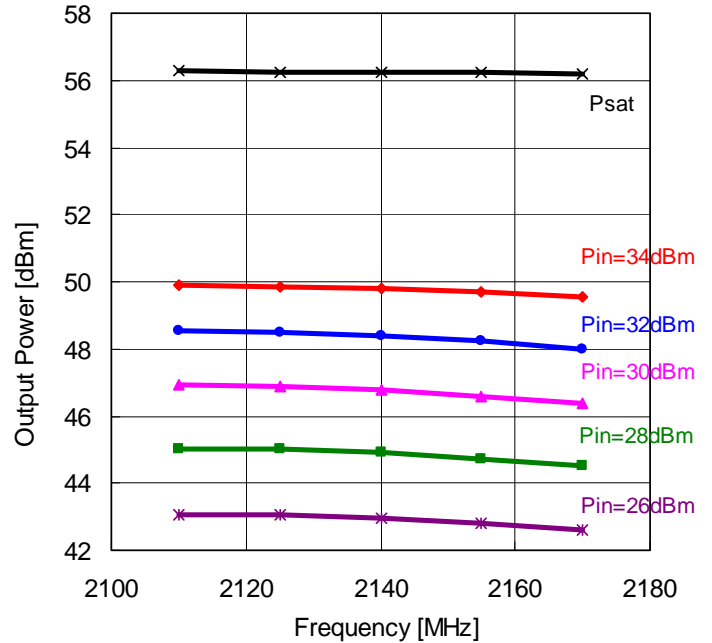
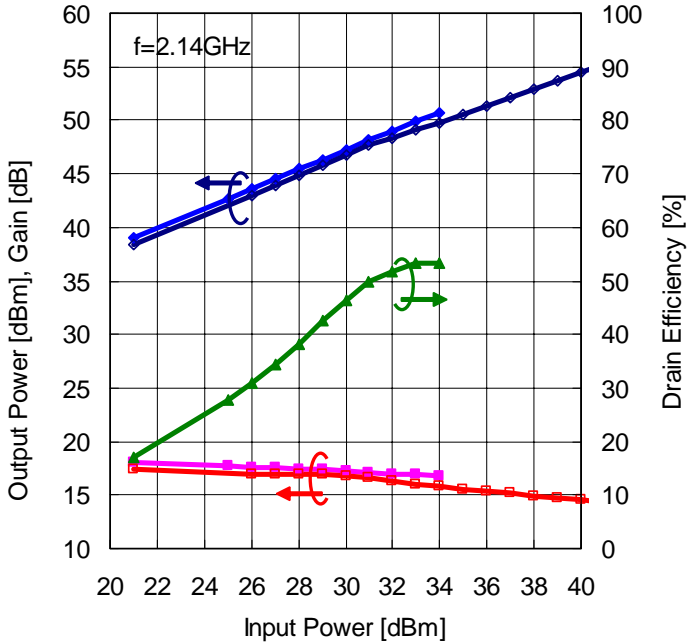
- Application DATA -

Doherty Amplifier characteristics

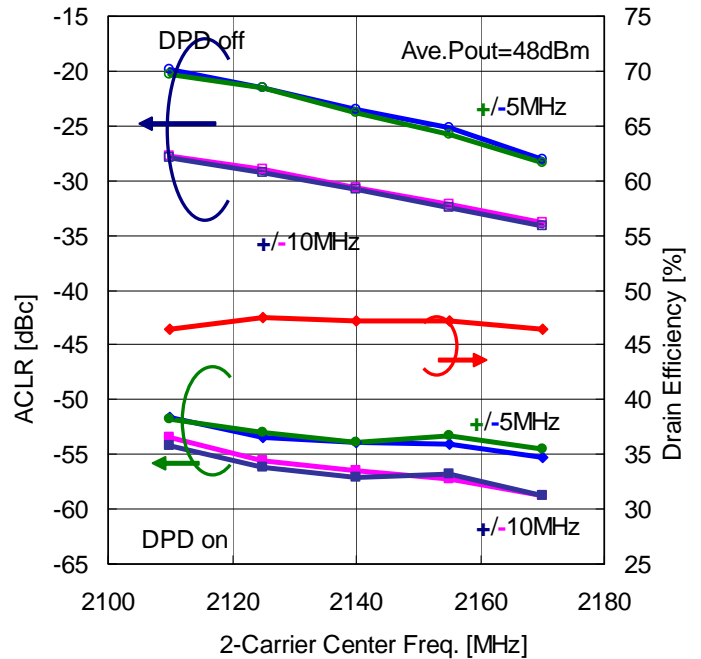
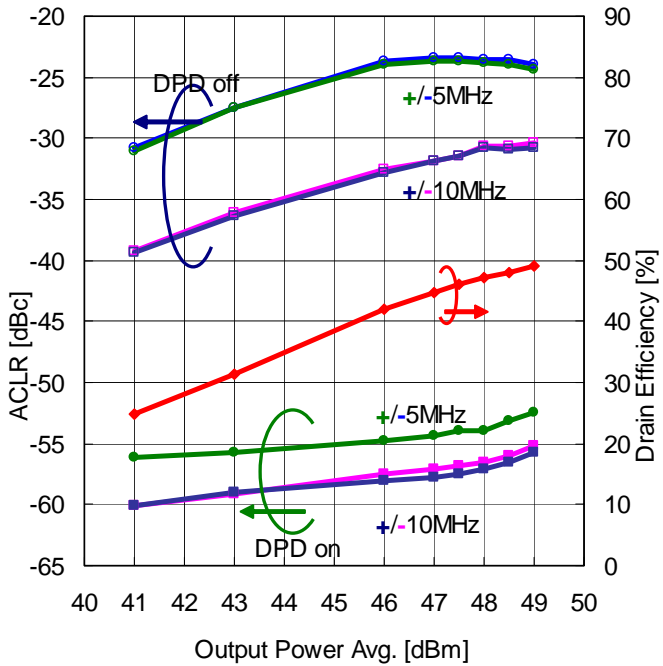
EGN21C210I2D

High Voltage - High Power GaN-HEMT

Test conditions : $V_{ds}=50V$, $I_{ds-main}=750mA$, $V_{gs-peak}=-3.5V$, Pulse Duty : 10% (6 μs /60 μs)



Test conditions : $V_{ds}=50V$, $I_{ds-main}=750mA$, $V_{gs-peak}=-3.5V$
W-CDMA 2-carrier, 5MHz Spacing, PAR=7.8dB(0.01%), $f_1=2137.5MHz$, $f_2=2142.5MHz$





GaN-HEMT 210W

EGN21C210I2D

High Voltage - High Power GaN-HEMT

I2D Package Outline Metal-Ceramic Hermetic Package

