

CF001 Series GaAs Pseudomorphic HEMT and MESFET Chips

- ❑ Super Low Noise: 0.8 dB at 12 GHz
- ❑ High Gain: Usable to 44 GHz
- ❑ P_{1dB} Power: Up to +19 dBm
- ❑ Active Layers Include:
Pseudomorphic HEMT, Epitaxial
and Ion Implanted
- ❑ Wafer Qualification Procedure
- ❑ Customer Wafer Selection Available

Celeritek CF001 Series Chips

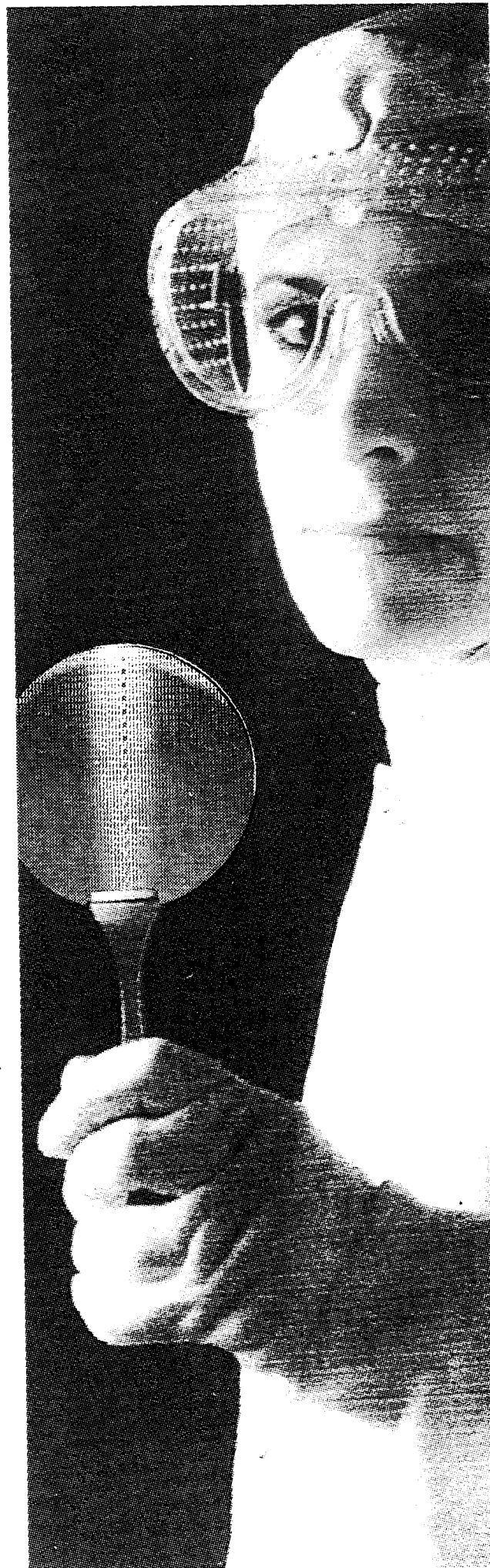
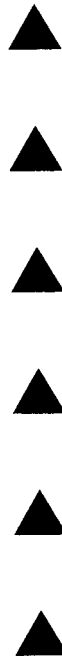
Celeritek CF001 Series chips are GaAs-based transistors which include the CF001-01, CF001-02 and CF001-03 models. They are 300 μm gate width, sub-half-micron gate length GaAs devices with Celeritek's proprietary Silicon Nitride passivation.

Celeritek's Wafer Qualification Procedure for CF001 Series FETs consists of DC, RF and reliability testing of both individual die and generic 6 to 18 GHz amplifier modules.

The CF001-01 provides high gain up to 26 GHz. It is suitable for general purpose and driver amplifier applications with up to +19 dBm power from a single FET. These devices can also be used in oscillator applications.

The CF001-03 model is Celeritek's state-of-the-art low noise and high associated gain GaAs Pseudomorphic HEMT device. It is suitable for narrow and wide band low noise and high gain amplifiers up to 40 GHz. Its rugged construction allows it to withstand the same input power as conventional MESFETs.

All CF001 Series devices are available in chip form and are suitable for airborne, shipboard and ground-based equipment. Screening includes MIL-STD-750 Class B, Class S and commercial screening. These devices are also available in packaged form. Please consult the CFB001 Series and CFA001 Series data sheets or contact the factory for further information.



CELERITEK

CF001 Series GaAs Chips

| Specifications ($T_A = 25^\circ\text{C}$) | | | | CF001-01 | | | CF001-02 | | | CF001-03 | | |
|---|--|-----------------|--------------------|---------------|------|------|-----------|------|------|--------------------|------|------|
| Active Layer | | | | Ion Implanted | | | Epitaxial | | | Pseudomorphic HEMT | | |
| Symbol | Parameters and Conditions | Frequency (GHz) | Units | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max |
| NF_{opt} | Optimum Noise Figure $V_{DS} = 3.0\text{ V}, I_{DS} = 15\text{ mA}$ | 12.0 | dB | | 1.6 | 2.4 | | 1.2 | 1.8 | | 0.8 | 1.2 |
| Ga | Gain at NF_{opt} $V_{DS} = 3.0\text{ V}, I_{DS} = 15\text{ mA}$ | 12.0 | dB | 7.5 | 8.5 | | 8.5 | 9.5 | | 9.5 | 10.5 | |
| $ S_{21} ^2$ | 50 Ohm Insertion Gain $V_{DS} = 6.0\text{ V}, I_{DS} = 40\text{ mA}$ | 2.0 | dB | | 13.0 | | | 14.0 | | | 15.0 | |
| | | 10.0 | dB | | 9.5 | | | 10.5 | | | 11.5 | |
| | | 18.0 | dB | | 6.0 | | | 7.0 | | | 8.0 | |
| P_{1dB} | Power Output @ 1 dB GC $V_{DS} = 6.0\text{ V}, I_{DS} = 40\text{ mA}$ | 12.0 | dBm | | 19.0 | | | 17.0 | | | 17.0 | |
| g_m | Transconductance $V_{DS} = 3.0\text{ V}, V_{GS} = 0\text{ V}$ | | mS | | 60 | | | 75 | | | 90 | |
| I_{DSS} | Drain Current $V_{DS} = 3.0\text{ V}, V_{GS} = 0\text{ V}$ | | mA | 40 | 60 | 120 | 30 | 60 | 120 | 30 | 60 | 120 |
| V_p | Pinchoff Voltage $V_{DS} = 3.0\text{ V}, I_{DS} = 1\text{ mA}$ | | Volts | -0.7 | -1.3 | -2.5 | -0.5 | -1.3 | -2.5 | -0.5 | -1.3 | -2.5 |
| BV_{GD} | Breakdown Voltage, Gate-Drain $I_{GD} = 100\text{ }\mu\text{A}$ | | Volts | -5.5 | -8.0 | | -5.5 | -8.0 | | -5.5 | -8.0 | |
| R_{th} | Thermal Resistance | | $^\circ\text{C/W}$ | | 150 | | | 150 | | | 150 | |

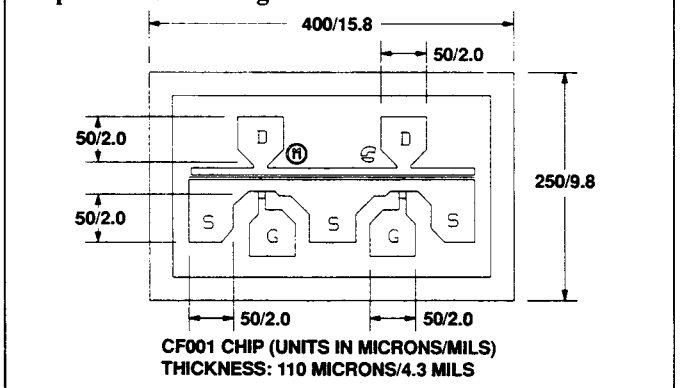
Absolute Maximum Ratings

| Parameter | Symbol | Ratings |
|------------------------|-----------|---|
| Drain-Source Voltage | V_{DS} | 8V |
| Gate-Source Voltage | V_{GS} | -5V |
| Drain Current | I_{DS} | I_{DSS} |
| Continuous Dissipation | P_T | 800 mW |
| Channel Temperature | T_{CH} | 175 $^\circ\text{C}$ |
| Storage Temperature | T_{STG} | -65 $^\circ\text{C}$ to +175 $^\circ\text{C}$ |

Typical Noise Parameters - CF001-03 $V_{DS} = 3.0\text{ V}, I_{DS} = 15\text{ mA}$

| Frequency (GHz) | NF_{opt} (dB) | Ga (dB) | Gamma opt (Mag) | Gamma opt (Ang) | Rn/50 |
|-----------------|-----------------|---------|-----------------|-----------------|-------|
| 2.0 | 0.35 | 19.4 | 0.85 | 9 | 0.69 |
| 4.0 | 0.43 | 16.2 | 0.76 | 19 | 0.48 |
| 6.0 | 0.51 | 14.0 | 0.70 | 35 | 0.38 |
| 8.0 | 0.60 | 12.4 | 0.65 | 54 | 0.31 |
| 10.0 | 0.70 | 11.4 | 0.60 | 73 | 0.26 |
| 12.0 | 0.80 | 10.8 | 0.55 | 90 | 0.21 |
| 14.0 | 0.91 | 10.2 | 0.52 | 107 | 0.17 |
| 16.0 | 1.02 | 9.8 | 0.49 | 123 | 0.12 |
| 18.0 | 1.14 | 9.3 | 0.48 | 142 | 0.09 |
| 20.0 | 1.27 | 8.8 | 0.49 | 162 | 0.06 |
| 22.0 | 1.40 | 8.2 | 0.53 | -179 | 0.05 |
| 24.0 | 1.54 | 7.6 | 0.58 | -165 | 0.05 |
| 26.0 | 1.68 | 7.0 | 0.58 | -161 | 0.08 |

Chip Outline Drawing

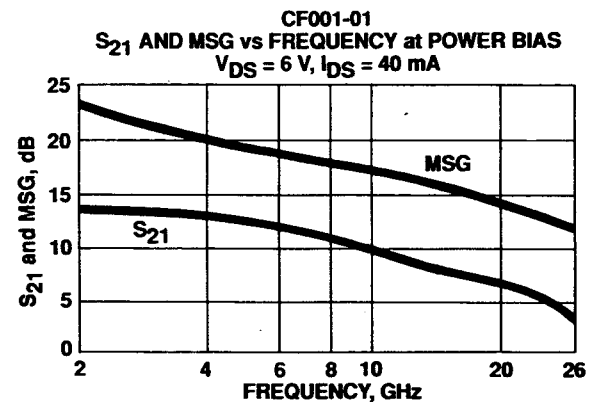
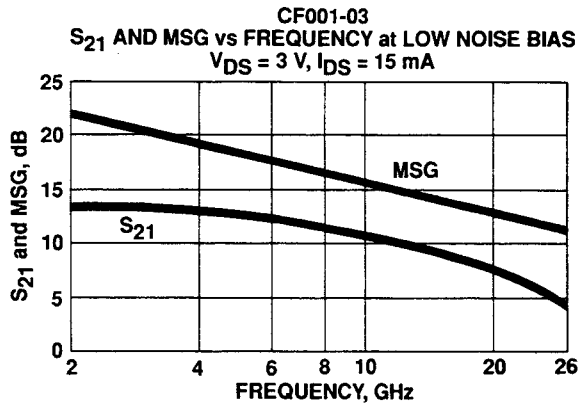
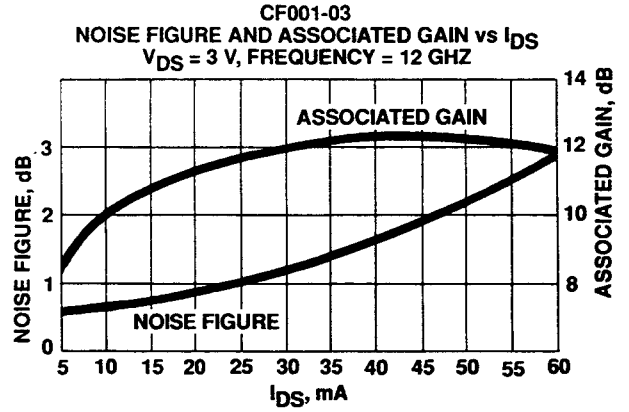
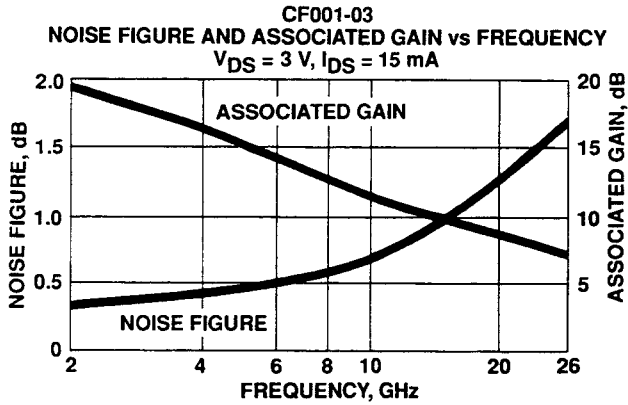


Die Attach and Bonding Procedures

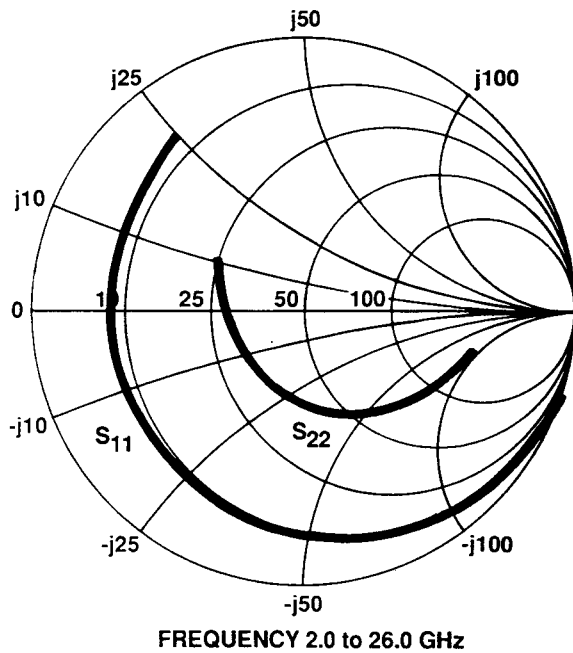
Die Attach: Conductive epoxy or eutectic die attach is recommended. For eutectic die attach: Preform: AuSn (80% Au, 20% Sn); Stage Temperature: 290 $^\circ\text{C}$, $\pm 5^\circ\text{C}$; Handling Tool: Tweezers; Time: 1 min or less.

Wire Bonding: Wire Size: 0.7 to 1.0 mil in diameter (pre-stressed); Thermocompression bonding is preferred over thermosonic bonding. For thermocompression bonding: Stage Temperature: 250 $^\circ\text{C}$; Bond Tip Temperature: 150 $^\circ\text{C}$; Bonding Tip Pressure: 18 to 40 gms depending on size of wire.

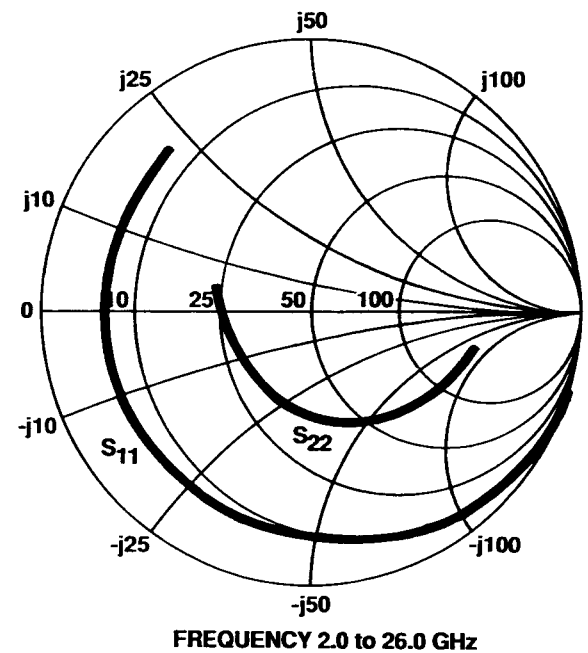
Typical Performance ($T_A = 25^\circ\text{C}$)



CF001-03
 S_{11} AND S_{22} vs FREQUENCY at LOW NOISE BIAS
 $V_{DS} = 3\text{ V}, I_{DS} = 15\text{ mA}$



CF001-01
 S_{11} AND S_{22} vs FREQUENCY at POWER BIAS
 $V_{DS} = 6\text{ V}, I_{DS} = 40\text{ mA}$



CF001 Series GaAs Chips

Typical Scattering Parameters, Common Source (S-Parameters Include Bonding Wire Parasitics)

CF001-01 at Power Bias

$V_{DS} = 6\text{ V}, I_{DS} = 40\text{ mA}$

| Frequency (GHz) | S_{11} | | S_{21} | | S_{12} | | S_{22} | | K | MSG (dB) | | |
|-----------------|----------|-------|----------|-------|----------|-------|----------|-------|------|----------|------|------|
| | (Mag) | (Ang) | (dB) | (Mag) | (Ang) | (dB) | (Mag) | (Ang) | | | | |
| 2.0 | 0.98 | -24 | 13.2 | 4.56 | 156 | -33.2 | 0.02 | 73 | 0.53 | -10 | 0.27 | 23.2 |
| 4.0 | 0.93 | -51 | 12.7 | 4.31 | 136 | -27.7 | 0.04 | 62 | 0.50 | -25 | 0.34 | 20.2 |
| 6.0 | 0.88 | -72 | 11.7 | 3.83 | 118 | -25.3 | 0.05 | 51 | 0.48 | -35 | 0.46 | 18.5 |
| 8.0 | 0.84 | -98 | 10.8 | 3.47 | 100 | -23.8 | 0.06 | 38 | 0.43 | -51 | 0.55 | 17.3 |
| 10.0 | 0.79 | -122 | 9.5 | 2.99 | 82 | -24.1 | 0.06 | 23 | 0.38 | -68 | 0.83 | 16.8 |
| 12.0 | 0.79 | -140 | 8.4 | 2.64 | 67 | -23.3 | 0.07 | 18 | 0.38 | -83 | 0.79 | 15.9 |
| 14.0 | 0.78 | -154 | 7.6 | 2.41 | 55 | -23.2 | 0.07 | 10 | 0.39 | -93 | 0.86 | 15.4 |
| 16.0 | 0.78 | -166 | 7.1 | 2.27 | 44 | -22.5 | 0.07 | 5 | 0.36 | -101 | 0.90 | 14.8 |
| 18.0 | 0.77 | 178 | 6.7 | 2.16 | 30 | -21.8 | 0.08 | -2 | 0.32 | -113 | 0.93 | 14.2 |
| 20.0 | 0.76 | 159 | 6.2 | 2.04 | 15 | -21.0 | 0.09 | -13 | 0.27 | -131 | 0.95 | 13.6 |
| 22.0 | 0.79 | 141 | 5.2 | 1.82 | -2 | -20.8 | 0.09 | -20 | 0.27 | -163 | 0.91 | 13.0 |
| 24.0 | 0.78 | 132 | 3.7 | 1.52 | -13 | -20.9 | 0.09 | -21 | 0.30 | 176 | 1.12 | 12.3 |
| 26.0 | 0.81 | 129 | 2.3 | 1.31 | -21 | -20.5 | 0.09 | -19 | 0.39 | 168 | 0.91 | 11.4 |

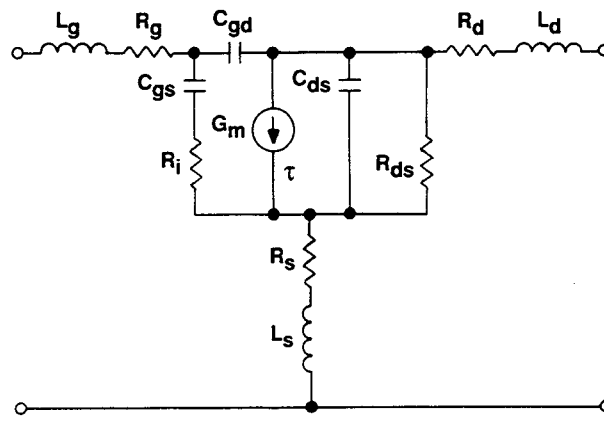
CF001-03 at Low Noise Bias

$V_{DS} = 3\text{ V}, I_{DS} = 15\text{ mA}$

| Frequency (GHz) | S_{11} | | S_{21} | | S_{12} | | S_{22} | | K | MSG (dB) | | |
|-----------------|----------|-------|----------|-------|----------|-------|----------|-------|------|----------|------|------|
| | (Mag) | (Ang) | (dB) | (Mag) | (Ang) | (dB) | (Mag) | (Ang) | | | | |
| 2.0 | 0.99 | -24 | 13.2 | 4.57 | 160 | -30.8 | 0.03 | 76 | 0.57 | -16 | 0.08 | 22.0 |
| 4.0 | 0.95 | -50 | 12.9 | 4.43 | 140 | -25.0 | 0.06 | 61 | 0.54 | -32 | 0.16 | 19.0 |
| 6.0 | 0.90 | -69 | 12.1 | 4.02 | 124 | -22.7 | 0.07 | 50 | 0.52 | -43 | 0.25 | 17.4 |
| 8.0 | 0.85 | -93 | 11.5 | 3.76 | 106 | -21.0 | 0.09 | 35 | 0.46 | -60 | 0.33 | 16.2 |
| 10.0 | 0.79 | -118 | 10.6 | 3.38 | 88 | -20.5 | 0.09 | 20 | 0.40 | -79 | 0.47 | 15.5 |
| 12.0 | 0.78 | -139 | 9.8 | 3.08 | 73 | -19.6 | 0.10 | 10 | 0.38 | -95 | 0.46 | 14.7 |
| 14.0 | 0.77 | -156 | 9.1 | 2.85 | 60 | -19.4 | 0.11 | 1 | 0.35 | -107 | 0.52 | 14.2 |
| 16.0 | 0.76 | -171 | 8.6 | 2.69 | 46 | -18.6 | 0.12 | -8 | 0.31 | -120 | 0.55 | 13.6 |
| 18.0 | 0.77 | 171 | 8.0 | 2.52 | 32 | -18.2 | 0.12 | -18 | 0.25 | -142 | 0.59 | 13.1 |
| 20.0 | 0.76 | 152 | 7.4 | 2.35 | 16 | -17.9 | 0.13 | -29 | 0.22 | -171 | 0.64 | 12.6 |
| 22.0 | 0.79 | 136 | 6.3 | 2.05 | 0 | -17.7 | 0.13 | -38 | 0.26 | 158 | 0.60 | 12.0 |
| 24.0 | 0.77 | 129 | 4.7 | 1.72 | -10 | -18.3 | 0.12 | -39 | 0.30 | 145 | 0.78 | 11.5 |
| 26.0 | 0.80 | 125 | 3.6 | 1.52 | -17 | -18.2 | 0.12 | -39 | 0.36 | 145 | 0.70 | 10.9 |

Device Model

| Parameters | CF001-01 $V_{DS} = 6\text{ V}, I_{DS} = 40\text{ mA}$ | CF001-03 $V_{DS} = 3\text{ V}, I_{DS} = 15\text{ mA}$ | Units |
|------------|--|--|----------|
| L_g | 0.19 | 0.26 | nH |
| R_g | 1.0 | 1.0 | Ω |
| C_{gs} | 0.32 | 0.24 | pF |
| R_i | 1.9 | 1.6 | Ω |
| C_{gd} | 0.023 | 0.029 | pF |
| G_m | 66 | 66 | mS |
| τ | 2.7 | 2.1 | ps |
| C_{ds} | 0.12 | 0.10 | pF |
| R_{ds} | 161 | 171 | Ω |
| R_d | 1.3 | 1.3 | Ω |
| L_d | 0.21 | 0.23 | nH |
| R_s | 1.1 | 1.6 | Ω |
| L_s | 0.04 | 0.04 | nH |



Wafer Qualification Procedure

| | |
|--|---|
| 100% DC Test 100% Visual Insp. | |
| Sample Chip Performance Test | NF, Power, S-Parameters, IP3, Power Blast |
| Sample Circuit Performance Tests 6-18 GHz Module | NF, Power, Gain, VSWR |
| Reliability Assessment | Power Blast & Burn-In |
| 80% of tested samples must meet specifications for wafer acceptance. | |

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Specifications subject to change.

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