

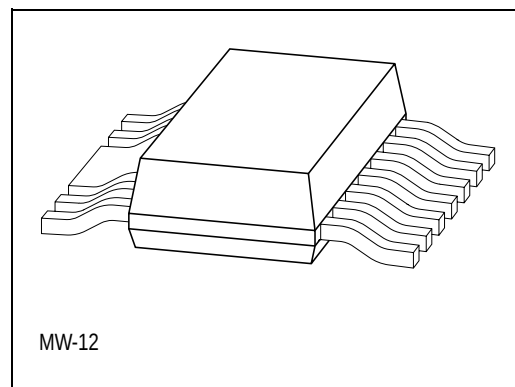
GaAs MMIC

Data Sheet

CGY 181

- Power amplifier for PCN/PCS applications
- Fully integrated 2 stage amplifier
- Operating voltage range: 2.7 to 6 V
- Overall power added efficiency 35%
- Input matched to 50 Ω , simple output match

ESD: **E**lectrostatic **d**ischarge sensitive device, observe handling precautions!



Type	Marking	Ordering Code (8-mm taped)	Package ¹⁾
CGY 181	CGY 181	Q68000-A8883	MW-12

¹⁾ Plastic body identical to P-SOT-223, dimensions see **Page 14**.

Maximum Ratings	Symbol	Value	Unit
Positive supply voltage	V_D	9	V
Negative supply voltage ¹⁾	V_G	– 8	V
Supply current	I_D	2	A
Channel temperature	T_{Ch}	150	°C
Storage temperature	T_{stg}	– 55 ... + 150	°C
RF input power	P_{in}	25	dBm
Total power dissipation ($T_s \leq 81$ °C) T_s : Temperature at soldering point	P_{tot}	5	W

¹⁾ $V_G = -8$ V only in combination with $V_{TR} = 0$ V; $V_G = -6$ V while $V_{TR} \neq 0$ V

Thermal Resistance	Symbol	Value	Unit
Channel-soldering point	R_{thChS}	≤ 14	K/W

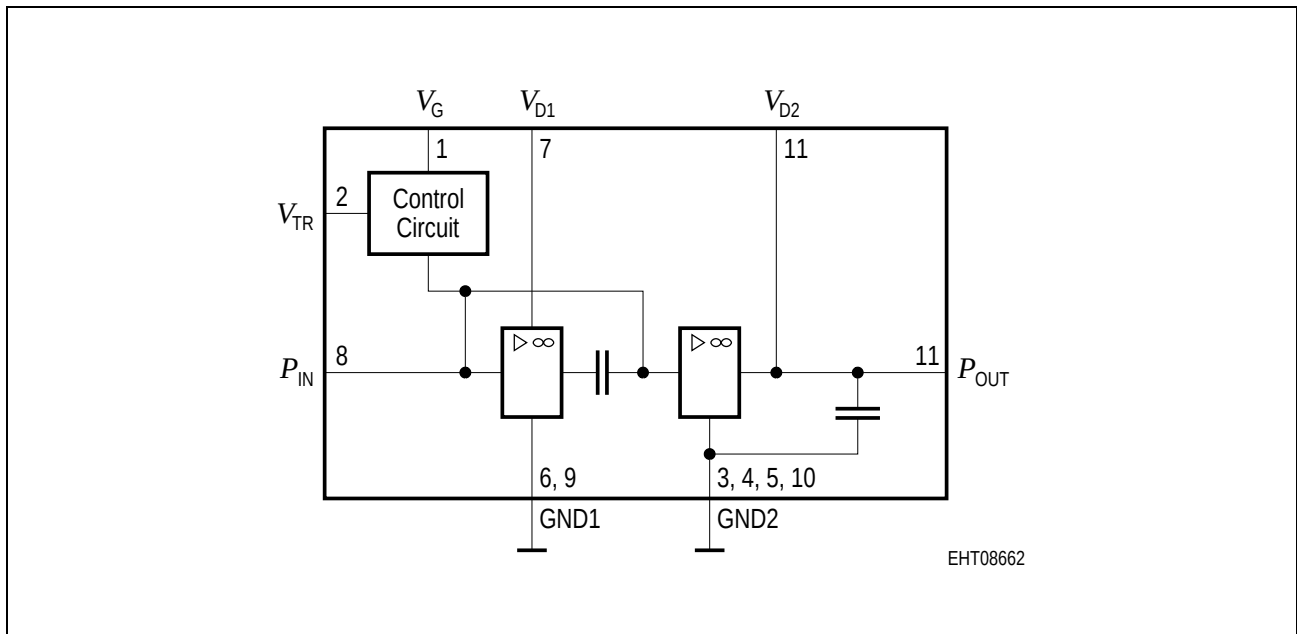


Figure 1 Functional Block Diagram

Short Description of CGY 181 Operation

A negative voltage between -4 V to -6 V (stabilization not necessary) has to be connected to the V_G -pin, a positive supply voltage has to be applied to the VD -pins.

The V_{TR} -pin has to be switched to 0 V (GND) during transmit operation. The MMIC CGY 181 is self-biased, the operating current is adjusted by the internal control circuit.

In receive mode the V_{TR} -pin is not connected (shut off mode).

Pin #	Symbol	Configuration
1	VG	Negative voltage at control circuit ($-4\text{ V} \dots -8\text{ V}$)
2	VTR	Control voltage for transmit mode (0 V) or receive mode (open)
3, 4, 5, 10	GND 2	RF and DC ground of the 2 nd stage
6, 9	GND 1	RF and DC ground of the 1 st stage
7	VD1	Positive drain voltage of the 1 st stage
8	RFin	RF input power
11	VD2, RFout	Positive drain voltage of the 2 nd stage, RF output power
12	–	not connected

DC Characteristics

Characteristics	Symbol	Limit Values			Unit	Test Conditions
		min.	typ.	max.		
Drain current (stage 1 and 2)	I_{DSS1}	0.6	0.9	1.2	A	$V_D = 3\text{ V}$, $V_G = 0\text{ V}$, V_{TR} n.c.
	I_{DSS2}	2.4	3.5	4.8	A	
Drain current with active current control	I_D	–	1.0	–	A	$V_D = 3\text{ V}$, $V_G = -4\text{ V}$, $V_{TR} = 0\text{ V}$
Transconductance (stage 1 and 2)	G_{fs1}	0.28	0.32	–	S	$V_D = 3\text{ V}$, $I_D = 350\text{ mA}$
	G_{fs2}	1.1	1.3	–	S	$V_D = 3\text{ V}$, $I_D = 700\text{ mA}$
Pinch off voltage	V_p	– 3.8	– 2.8	– 1.8	V	$V_D = 3\text{ V}$, $I_D < 500\text{ }\mu\text{A}$ (all stages)

Electrical Characteristics

$T_A = 25\text{ }^\circ\text{C}$, $f = 1.75\text{ GHz}$, $Z_S = Z_L = 50\text{ }\Omega$, $V_D = 3.6\text{ V}$, $V_g = -4\text{ V}$, VTR pin connected to ground; unless otherwise specified

Characteristics	Symbol	Limit Values			Unit	Test Conditions
		min.	typ.	max.		
Supply current	I_{DD}	–	1.2	–	A	$P_{in} = 0\text{ dBm}$
Negative supply current	I_G	–	2	3	mA	(normal operation)
Shut-off current	I_D	–	400	–	μA	VTR n.c.
Negative supply current	I_G	–	10	–	μA	(shut off mode, VTR pin n.c.)
Small signal gain	G	–	20.5	–	dB	$P_{in} = -5\text{ dBm}$
Power Gain	G	14.5	15.5	–	dB	$V_D = 3.6\text{ V}$, $P_{in} = 16\text{ dBm}$
Power Gain	G	17.5	18.5	–	dB	$V_D = 5\text{ V}$, $P_{in} = 16\text{ dBm}$

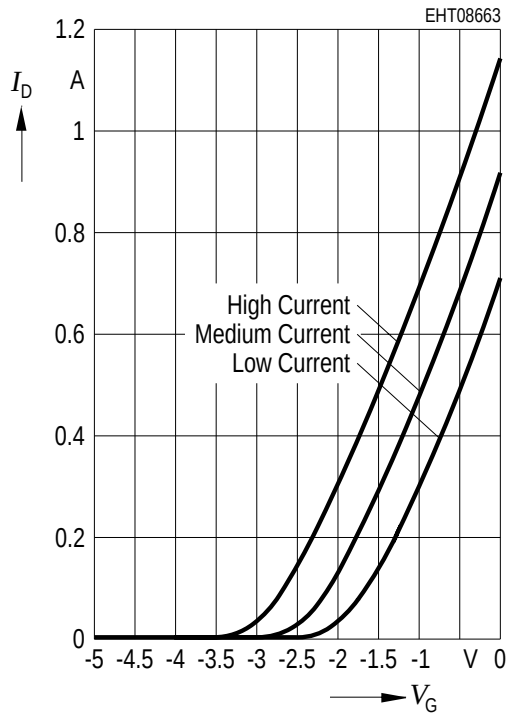
Electrical Characteristics (cont'd)

$T_A = 25\text{ }^{\circ}\text{C}$, $f = 1.75\text{ GHz}$, $Z_S = Z_L = 50\text{ }\Omega$, $V_D = 3.6\text{ V}$, $V_g = -4\text{ V}$, VTR pin connected to ground; unless otherwise specified

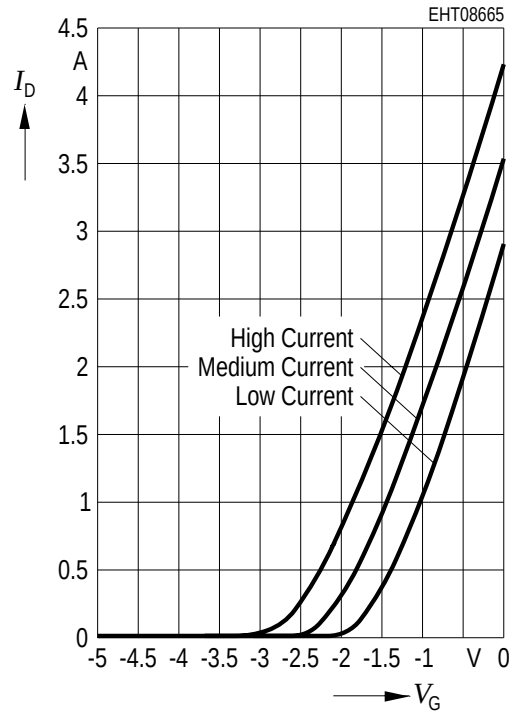
Characteristics	Symbol	Limit Values			Unit	Test Conditions
		min.	typ.	max.		
Output Power	P_0	30.5	31.5	–	dBm	$V_D = 3.6\text{ V}$, $P_{in} = 16\text{ dBm}$
Output Power	P_0	33.5	34.5	–	dBm	$V_D = 5\text{ V}$, $P_{in} = 16\text{ dBm}$
Overall Power Added Efficiency	η	–	37	–	%	$V_D = 3.6\text{ V}$, $P_{in} = 16\text{ dBm}$
Overall Power Added Efficiency	η	–	35	–	%	$V_D = 5\text{ V}$, $P_{in} = 16\text{ dBm}$
Harmonics $2f_0$ $3f_0$	–	–	– 44.8 – 70	–	dBc	$P_{in} = 16\text{ dBm}$, $V_D = 3.6\text{ V}$, $P_{out} = 31.85\text{ dBm}$
Harmonics $2f_0$ $3f_0$	–	–	– 45.1 – 75	–	dBc	$P_{in} = 16\text{ dBm}$, $V_D = 5\text{ V}$, $P_{out} = 31.85\text{ dBm}$
Input VSWR	–	–	1.9:1	–	–	$V_D = 3.6\text{ V}$
Third order intercept point	IP_3	–	41	–	dBm	$f_1 = 1.7500\text{ GHz}$; $f_2 = 1.7502\text{ GHz}$; $V_D = 3.6\text{ V}$
Third order intercept point	IP_3	–	44	–	dBm	$f_1 = 1.7500\text{ GHz}$; $f_2 = 1.7502\text{ GHz}$; $V_D = 5\text{ V}$

All RF-measurements were done in a pulsed mode with a duty cycle of 10% ($t_{on} = 0.33\text{ ms}$)!

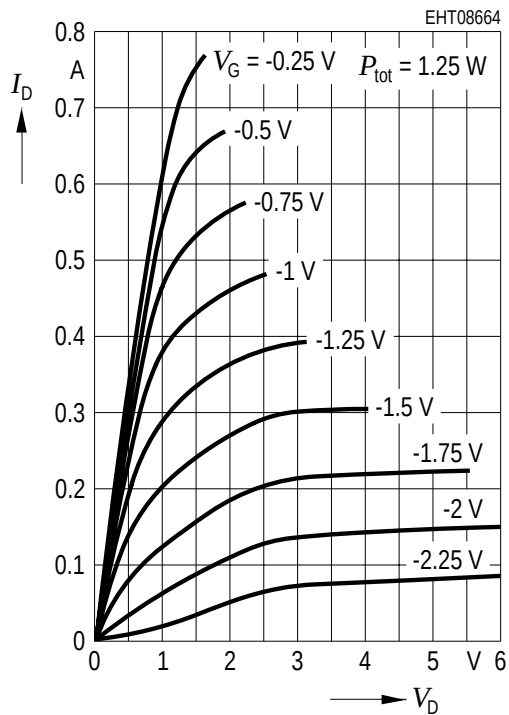
DC- I_D (V_G) Characteristics - Typical Values of Stage 1, $V_D = 3$ V



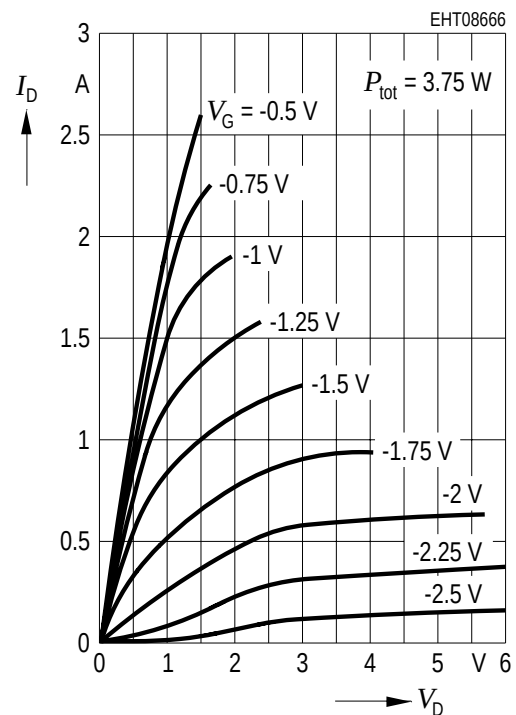
DC- I_D (V_G) Characteristics - Typical Values of Stage 2, $V_D = 3$ V



DC-Output Characteristics - Typical Values of Stage 1*

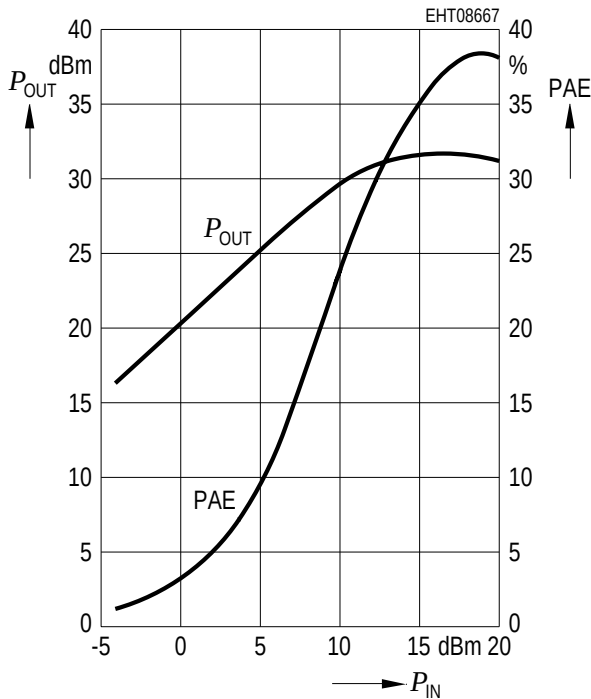


DC-Output Characteristics - Typical Values of Stage 2*

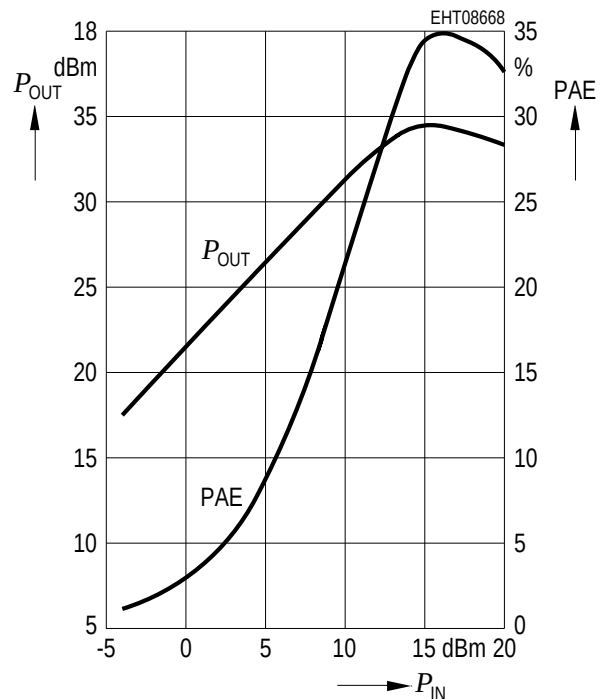


*Pin 2 (V_{TR}) has to be open during measuring DC-characteristics!

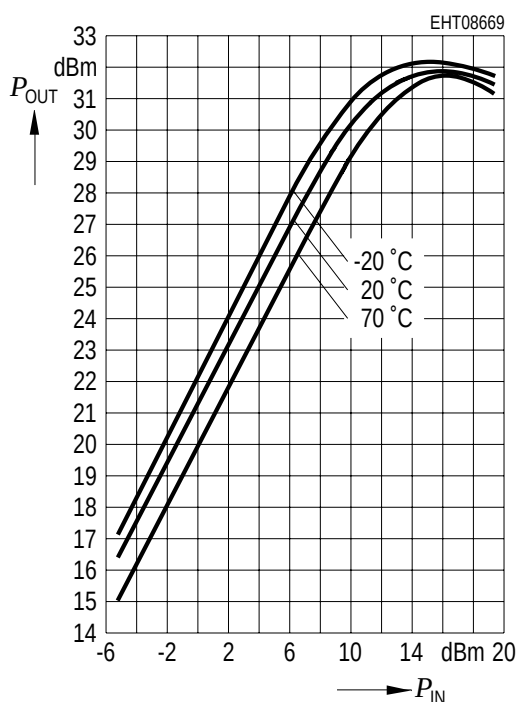
**P_{out} and PAE vs. P_{in} , $V_D = 3.6$ V,
 $V_G = -4$ V, $f = 1.75$ GHz, pulsed with a
duty cycle of 10% ($t_{on} = 0.33$ ms)**



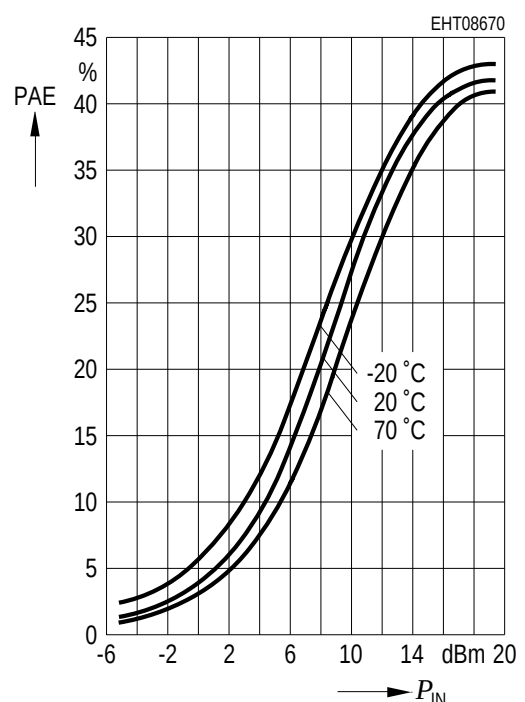
**P_{out} and PAE vs. P_{in} , $V_D = 5$ V,
 $V_G = -4$ V, $f = 1.75$ GHz, pulsed with a
duty cycle of 10% ($t_{on} = 0.33$ ms)**



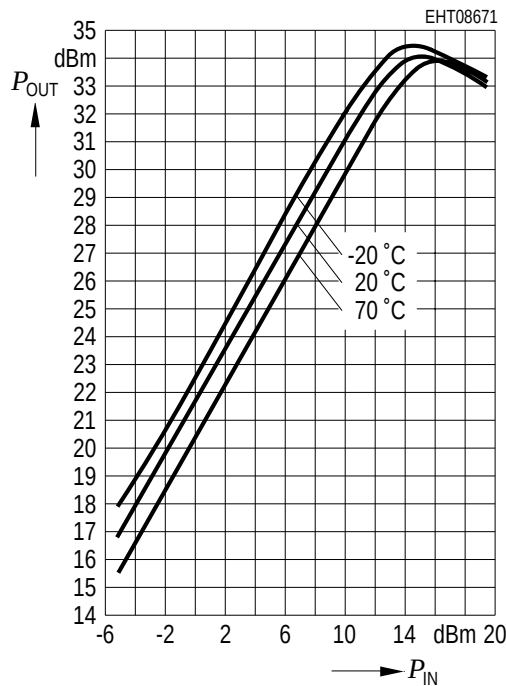
**Output Power at Different
Temperatures, $V_D = 3.6$ V,
 $V_G = -4$ V, $f = 1.75$ GHz, pulsed with a
duty cycle of 10% ($t_{on} = 0.33$ ms)**



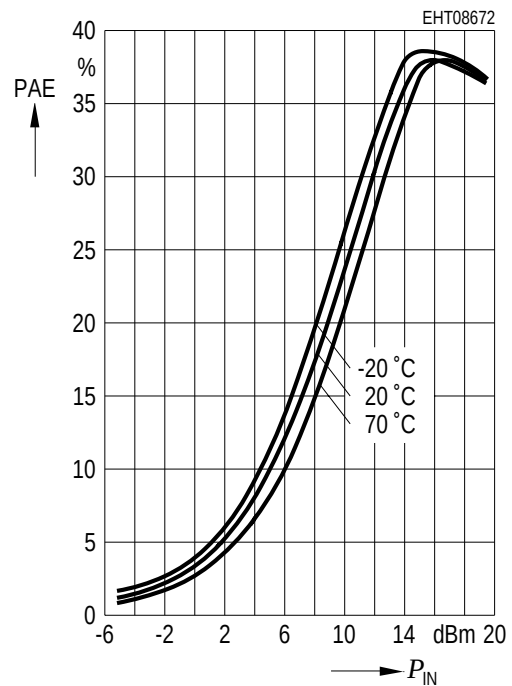
**Power Added Efficiency at Different
Temperatures, $V_D = 3.6$ V,
 $V_G = -4$ V, $f = 1.75$ GHz, pulsed with a
duty cycle of 10% ($t_{on} = 0.33$ ms)**



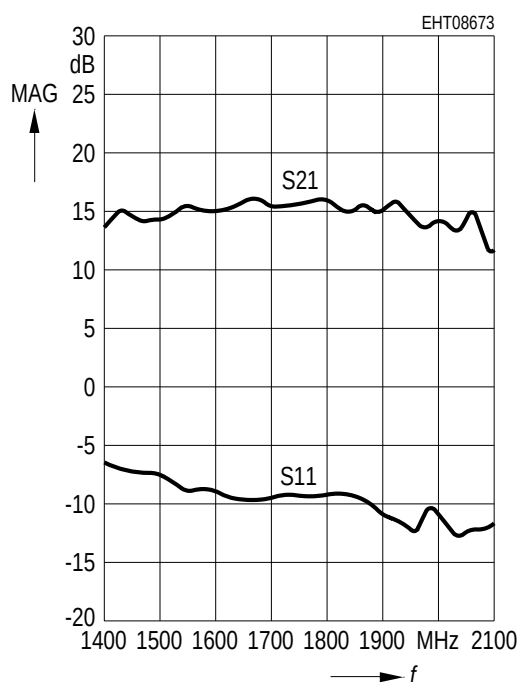
Output Power at Different Temperatures, $V_D = 5\text{ V}$, $V_G = -4\text{ V}$, $f = 1.75\text{ GHz}$, pulsed with a duty cycle of 10% ($t_{on} = 0.33\text{ ms}$)



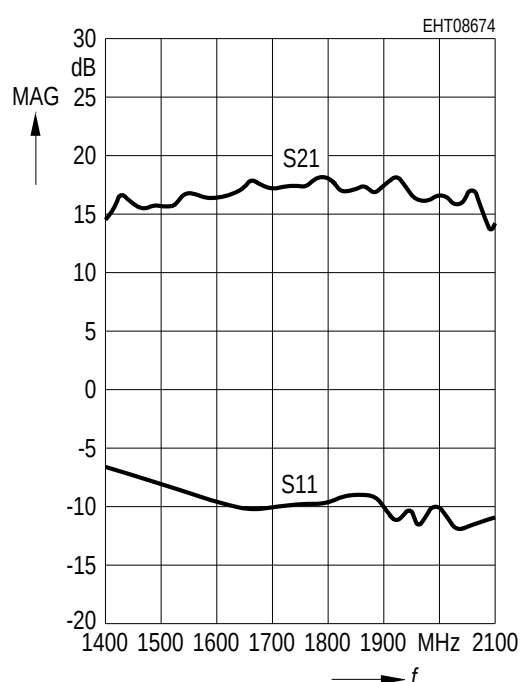
Power Added Efficiency at Different Temperatures, $V_D = 5\text{ V}$, $V_G = -4\text{ V}$, $f = 1.75\text{ GHz}$, pulsed with a duty cycle of 10% ($t_{on} = 0.33\text{ ms}$)



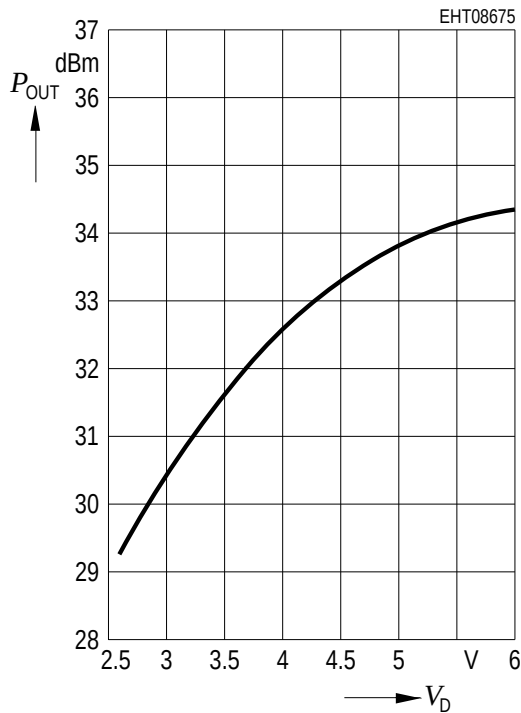
Measured S-Parameter at $V_D = 3.6\text{ V}$ and $P_{in} = 16\text{ dBm}$, $V_G = -4\text{ V}$, VTR connected to ground, pulsed with a duty cycle of 10% ($t_{on} = 0.33\text{ ms}$)



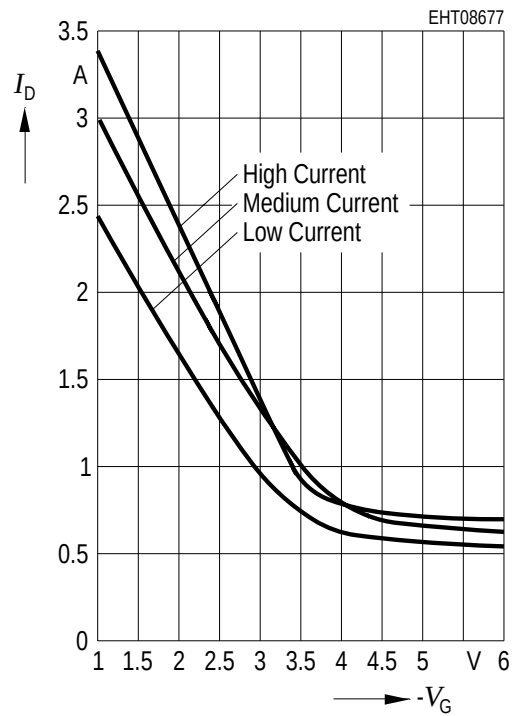
Measured S-Parameter at $V_D = 5\text{ V}$ and $P_{in} = 16\text{ dBm}$, $V_G = -4\text{ V}$, VTR connected to ground, pulsed with a duty cycle of 10% ($t_{on} = 0.33\text{ ms}$)



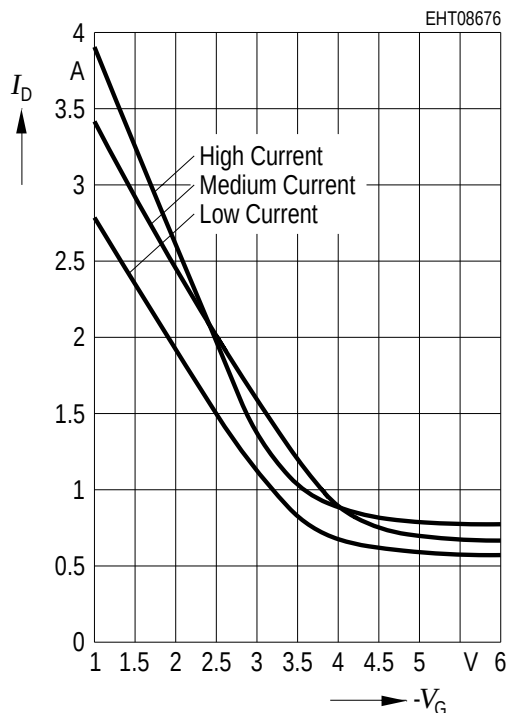
**P_{out} vs. V_D , $V_G = -4$ V, $f = 1.75$ GHz,
 $P_{in} = 16$ dBm, pulsed with a duty cycle of
10% ($t_{on} = 0.33$ ms)**



**Performance of Internal Bias Control
Circuit @ $V_D = 5$ V, $V_{TR} = 0$ V, pulsed with
a duty cycle of 10% ($t_{on} = 0.33$ ms)**

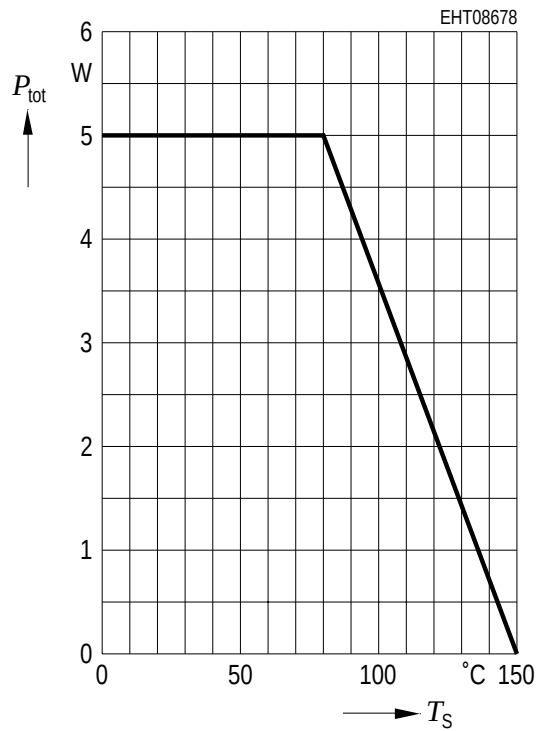


**Performance of Internal Bias Control
Circuit @ $V_D = 3$ V, $V_{TR} = 0$ V, pulsed with
a duty cycle of 10% ($t_{on} = 0.33$ ms)**



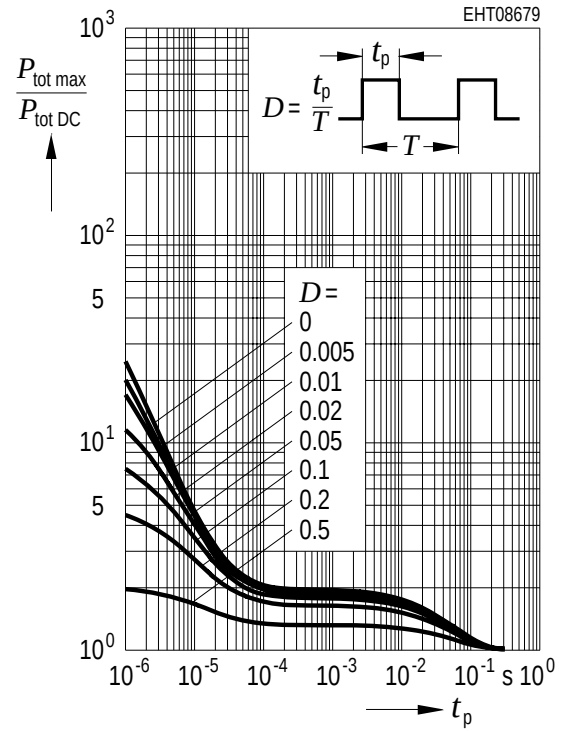
Total Power Dissipation

$$P_{\text{tot}} = f(T_S)$$



Permissible Pulse Load

$$P_{\text{tot_max}}/P_{\text{tot_DC}} = f(t_p)$$



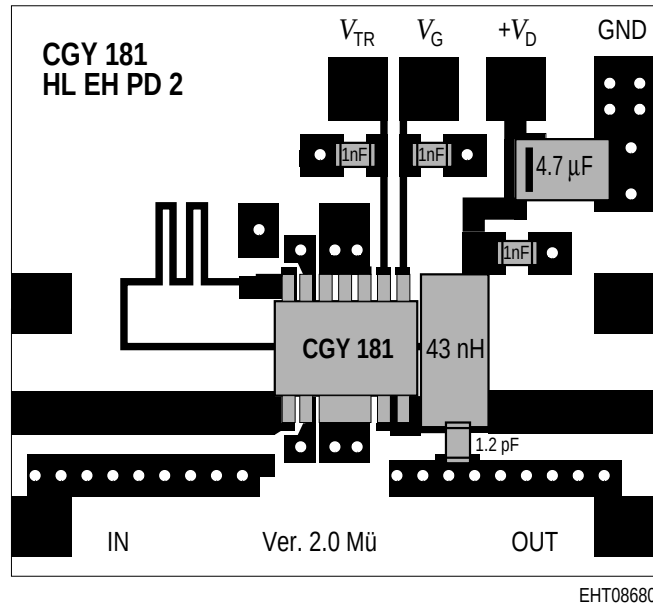


Figure 2 CGY 181 Application Board

Layout size is 30 mm × 26 mm.

Part Type	Description
CGY 181	Infineon GaAs-MMIC
1 nF	Capacitor SMD 0805
1 nF	Capacitor SMD 0805
1 nF	Capacitor SMD 0805
1 p2	Capacitor SMD 0805
4 µ7	Capacitor SMD Tantal
43 nH	Coilcraft SMD Spring Inductor B10T (distributed by Ginsbury Electronic GmbH, Am Moosfeld 85, D-81829 München Tel.: 089/45170-223)

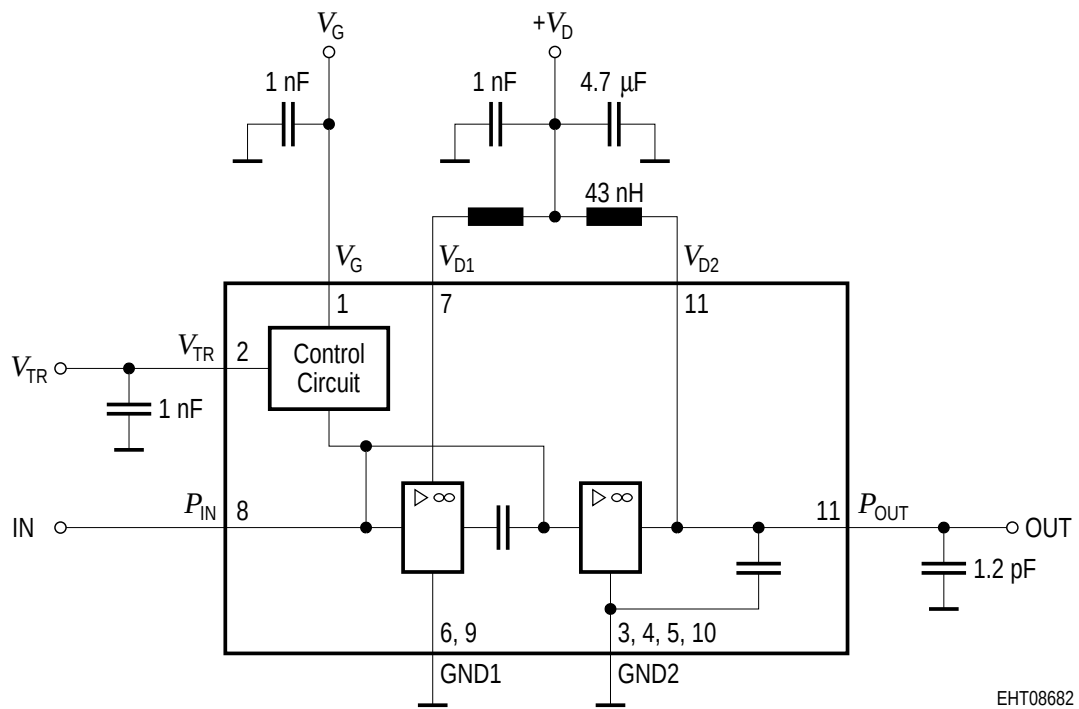


Figure 3 Principal Circuit

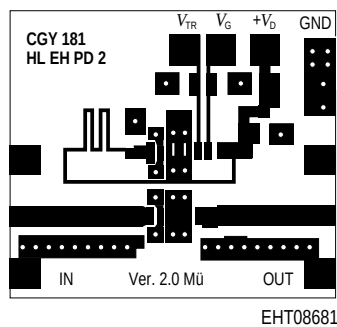


Figure 4 Original Size

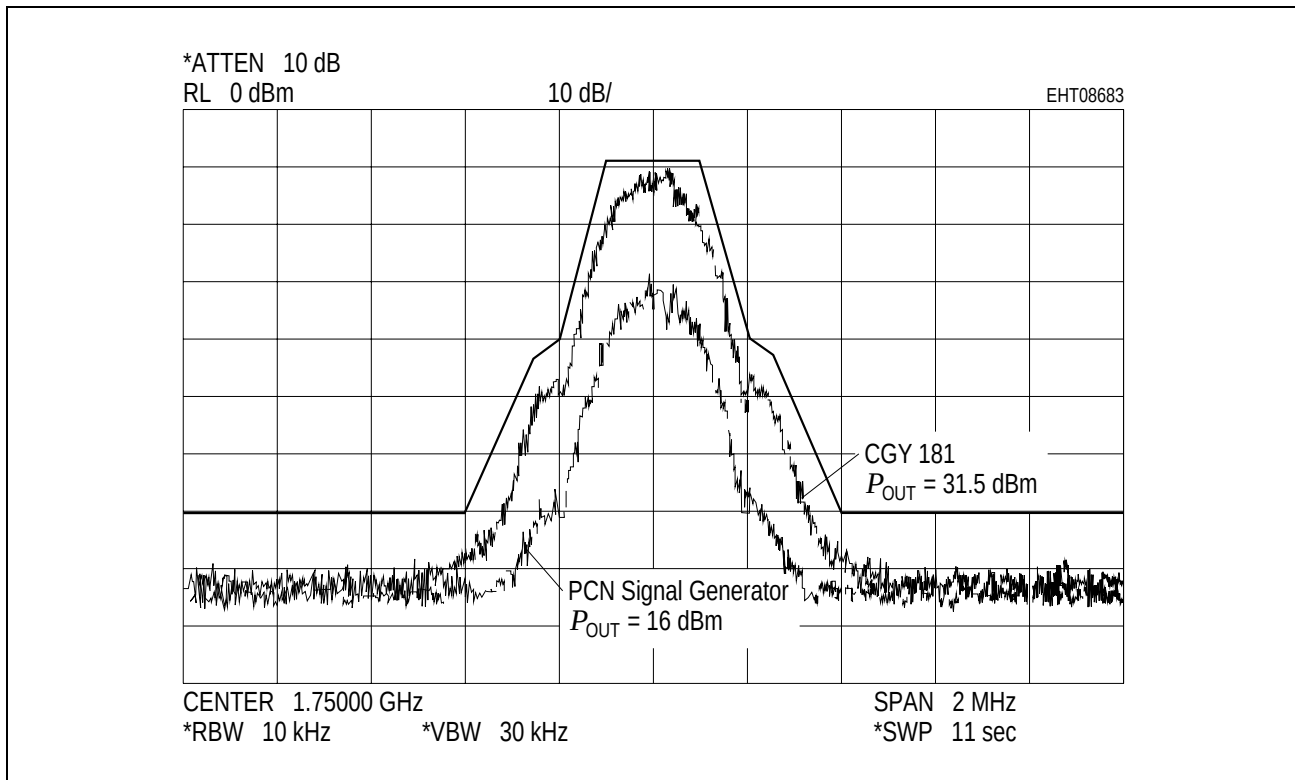


Figure 5 Emissions due to GMSK Modulation

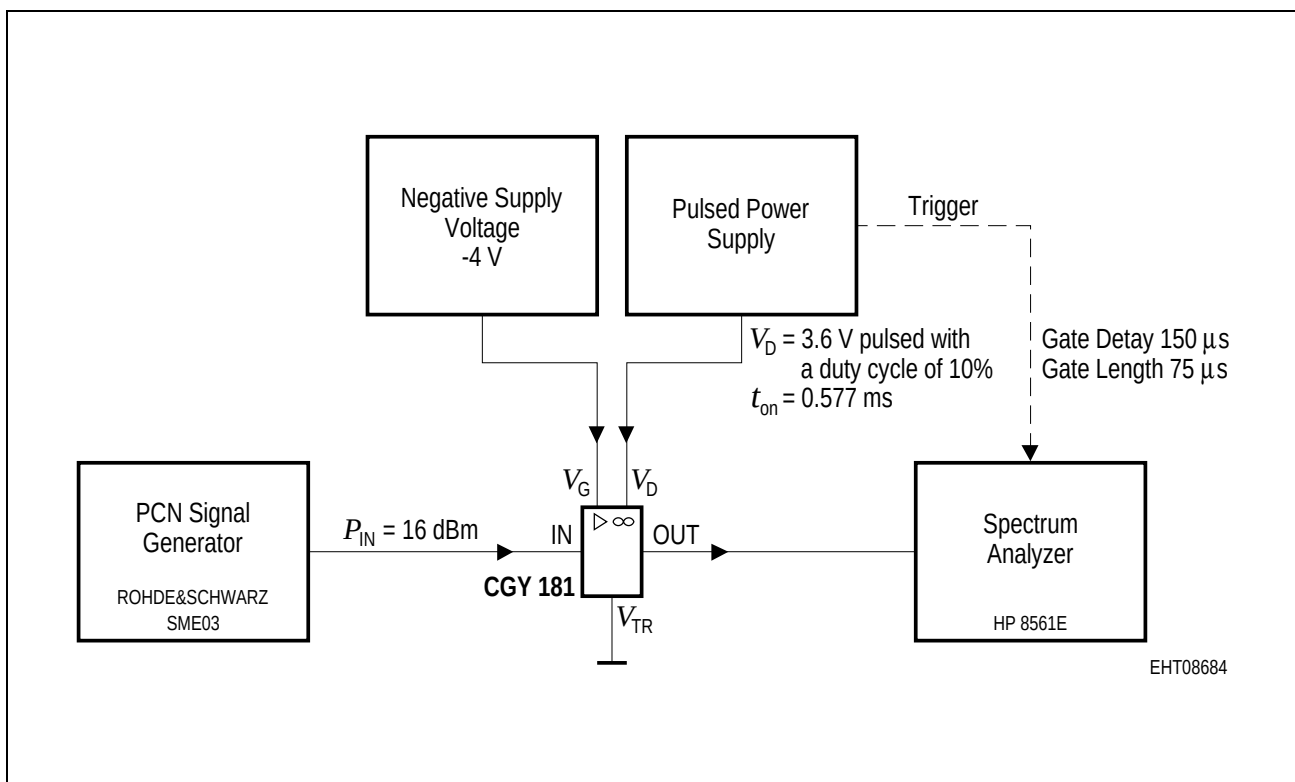


Figure 6 Measurement was Done with the Following Equipment

Application Hints

1. CW - Capability of the CGY 181

Proving the possibility of CW - operations there must be known the total power dissipation of the device. This value can be found as a function of temperature in the data sheet (**Page 9**). The CGY 181 has a maximum total power dissipation of $P_{\text{tot}} = 5 \text{ W}$.

As an example we take the operating point with a drain voltage $V_D = 3.6 \text{ V}$ and a typical drain current of $I_D = 1.2 \text{ A}$. So the maximum DC - power can be calculated to:

$$P_{\text{DC}} = V_D \times I_D = 4.32 \text{ W}$$

This value is smaller than 5 W and CW - operation is possible.

By decoupling RF power out of the CGY 181 the power dissipation of the device can be further reduced. Assuming a power added efficiency PAE of 35% the total power dissipation P_{tot} can be calculated using the following formula:

$$P_{\text{tot}} = P_{\text{DC}} \times (1 - \text{PAE}) = 4.32 \text{ W} \times (1 - 0.35) = 2.808 \text{ W}$$

2. Operation without Using the Internal Current Control

If you don't want to use the internal current control, it is recommended to connect the negative gate voltage at pin 2 (V_{TR}) instead of pin 1 (V_G). In that case V_G is not connected.

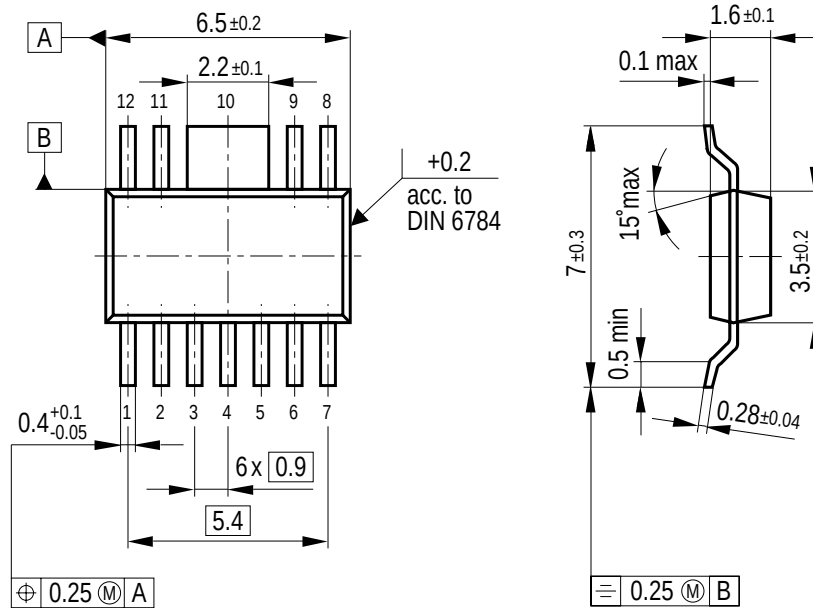
3. Biasing and Use Considerations

Biasing should be timed in such a way that the gate voltage (V_G) is always applied before the drain voltages (V_D), and when returning to the standby mode, the drain voltages have to be removed before the gate voltage.

Package Outlines

MW-12

(Special Package)



GPW05795

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm