ESAME DI ABILITAZIONE PROFESSIONALE
SESSIONE APRILE 2000
ELETTRONICI

TEMA n° 2

Si progetti lo stadio finale in microstriscia di un ponte radio a microonde attivo a rigenerazione del segnale in banda base posto su un altura.
Il sistema deve garantire un livello di campo specificato in un'area circolare sottostante l'altura come illustrato nella figura 1.
Si hanno le seguenti specifiche:

Frequenza della portante: 4 GHz.
Banda segnale IF: 5 MHz.
Raggio della zona da illuminare: 1 km.
Distanza d: 20 km (v. figura 1).
Intensità di Campo minima nella zona da illuminare: 866 [μV_{eff} / m].
Potenza del segnale di ingresso allo stadio finale: 15 dBm.
Impedenza di uscita del preamplificatore pari a: 50 Ohm.
Altezza dell'altura: 2000 m.
Temperatura di funzionamento: -10 + 40 °C.
Rendimento minimo ($\eta=(P_{rfout}- P_{rfin})/P_{dc}$): 25%.
Antenna a trombino quadrato, di guadagno massimo pari a 10 dB e di impedenza di ingresso pari a: 50 Ohm collegata con lo stadio finale da un cavo coassiale di 25 cm.
Microstriscia su substrato di duroid 6010, con costante dielettrica relativa pari a: 9.8 e spessore di 25 mil con metallizzazione di rame di 10μm di spessore.

Il progetto dovrà contenere:

1) Schema a blocchi del ponte Radio
2) Schema a blocchi dello stadio finale
3) Progetto dettagliato della struttura in microstriscia con layout del circuito.
4) Verifica del progetto considerando le perdite

Note di Progetto:
Si progetti il sistema considerando gli eventuali condensatori ideali.

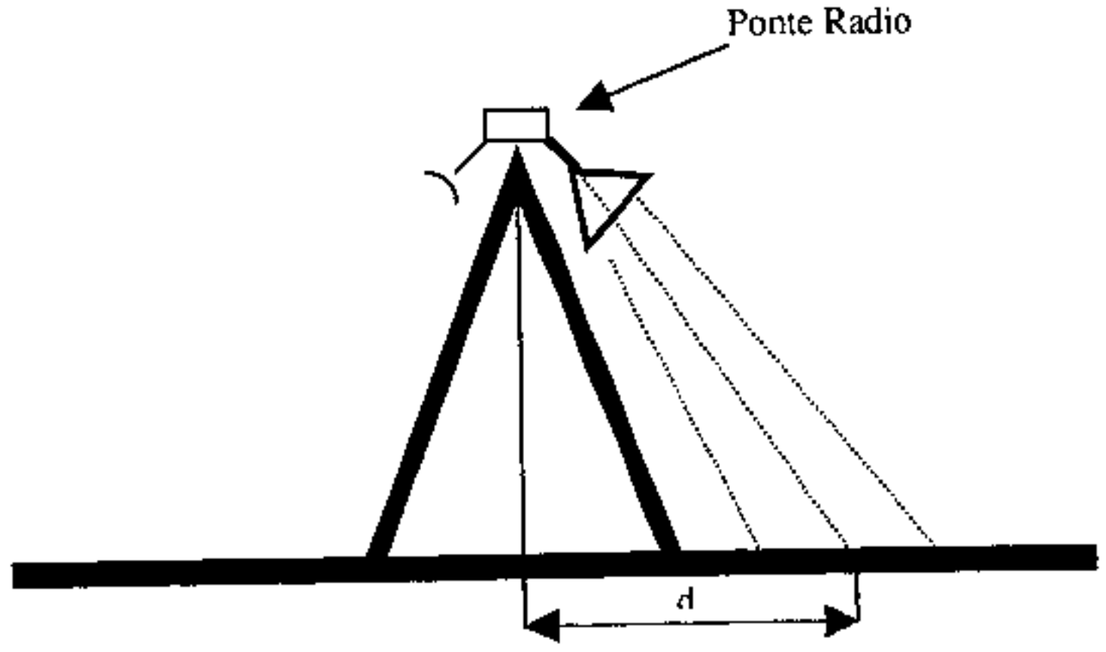


Figura 1

Agilent Technologies
Innovating the HP Way

2 – 10 GHz Medium Power Gallium Arsenide FET

Technical Data

ATF-46101

Features

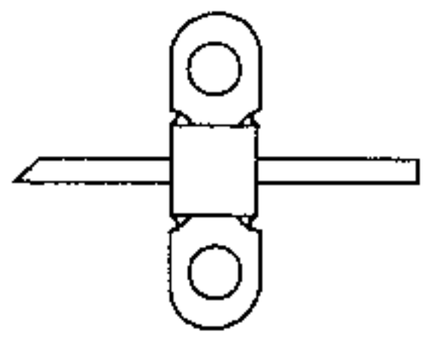
- **High Output Power:** 27.0 dBm Typical $P_{1\,dB}$ at 4 GHz
- **High Gain at 1 dB Compression:** 12.0 dB Typical $G_{1\,dB}$ at 4 GHz
- **High Power Efficiency:** 38% Typical at 4 GHz

Description

The ATF-46101 is a gallium arsenide Schottky-barrier-gate field effect transistor designed for medium power, linear amplification in the 2 to 10 GHz frequency range. This nominally 0.5 micron gate length GaAs FET is an interdigitated four-cell structure using airbridge interconnects between drain fingers. Total gate periphery is 1.25 millimeters. Proven gold based metallization systems and nitride passivation assure a rugged, reliable device.

This device is suitable for applications in space, airborne, military ground and shipboard, and commercial environments. It is supplied in a hermetic high reliability package with low parasitic reactance and minimum thermal resistance.

100 mil Flange Package



Electrical Specifications, T_A = 25°C

Symbol	Parameters and Test Conditions[1]		Units	Min.	Typ.	Max.
$P_{1\,dB}$	Power Output @ 1 dB Gain Compression: V_{DS} = 9 V, I_{DS} = 125 mA	f = 4.0 GHz f = 8.0 GHz	dBm	25.0	27.0 26.5	
$G_{1\,dB}$	1 dB Compressed Gain: V_{DS} = 9 V, I_{DS} = 125 mA	f = 4.0 GHz f = 8.0 GHz	dB	9.0	10.0 5.0	
η_{add}	Efficiency @ P_{1dB}: V_{DS} = 9 V, I_{DS} = 125 mA	f = 4.0 GHz	%		38	
g_m	Transconductance: V_{DS} = 2.5 V, I_{DS} = 125 mA		mmho		100	
I_{DSS}	Saturated Drain Current: V_{DS} = 2.5 V, V_{GS} = 0 V		mA	200	330	450
V_P	Pinch-off Voltage: V_{DS} = 2.5 V, I_{DS} = 5 mA		V	-5.4	-3.5	-2.0

Note:

1. RF Performance is determined by packaging and testing 10 samples per wafer.

ATF-46101 Absolute Maximum Ratings

Symbol	Parameter	Units	Absolute Maximum[1]
V_{DS}	Drain-Source Voltage	V	+14
V_{GS}	Gate-Source Voltage	V	-7
V_{GD}	Gate-Drain Voltage	V	-16
I_{DS}	Drain Current	mA	I_{DSS}
P_T	Power Dissipation [2,3]	W	2.0
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175

Notes:
1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{MOUNTING\ SURFACE}$ = 25°C.
3. Derate at 13 mW/°C for T_{CASE} > 25°C.
4. The small spot size of this technique results in a higher, though more accurate determination of θ_{jc} than io alternate methods. See MEASUREMENTS section for more information.

Thermal Resistance:	θ_{jc} = 75°C/W; T_{CH} = 150°C
Liquid Crystal Measurement:	1 µm Spot Size[4]

ATF-46101 Typical Performance, T_A = 25°C

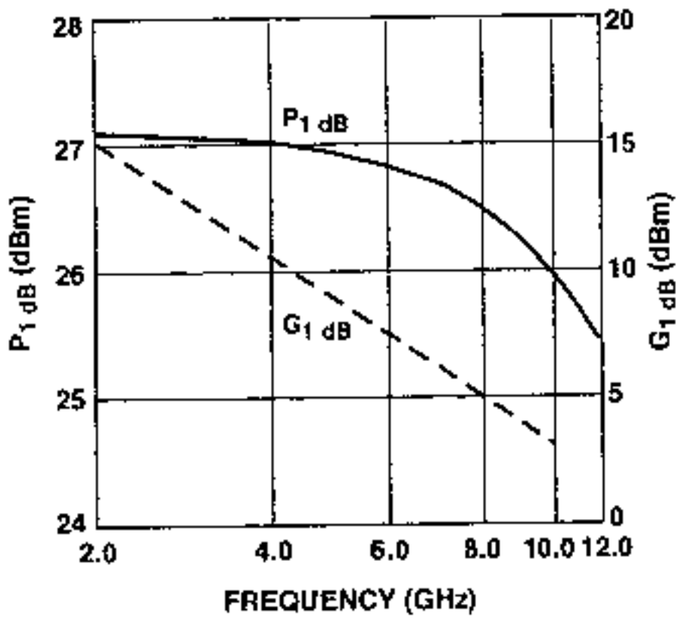


Figure 1. Power Output @ 1 dB Gain Compression and 1 dB Compressed Gain vs. Frequency.
V_{DS} = 9 V, I_{DS} = 125 mA.

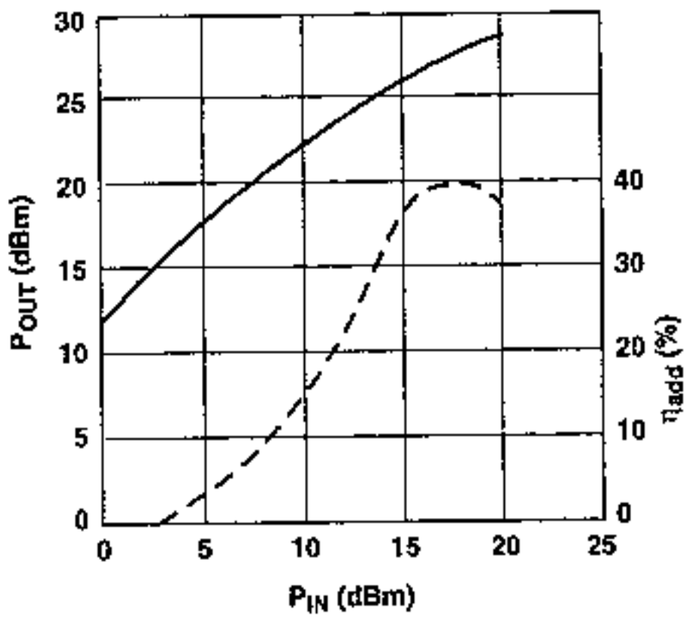


Figure 2. Output Power and Power Added Efficiency vs. Input Power.
V_{DS} = 9 V, I_{DS} = 125 mA, f = 4.0 GHz.

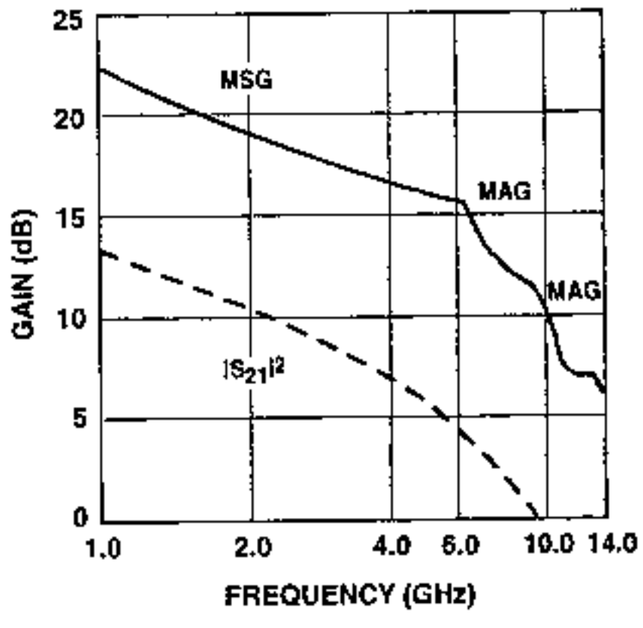


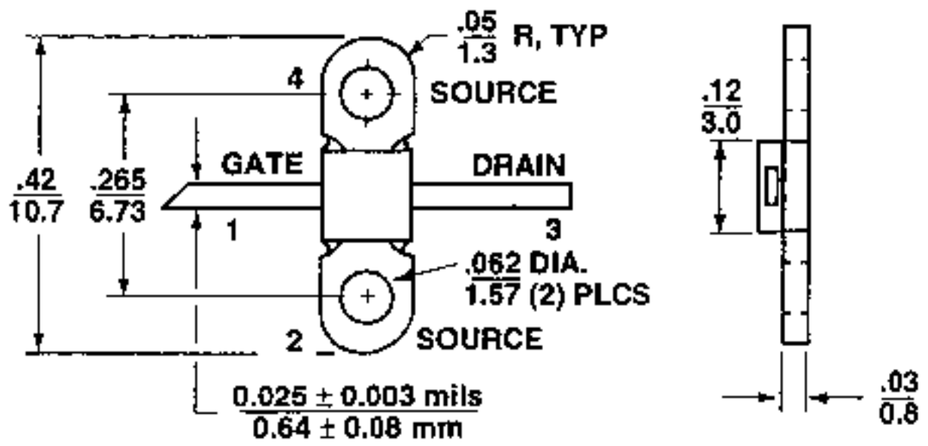
Figure 3. Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency.
V_{DS} = 9 V, I_{DS} = 125 mA.

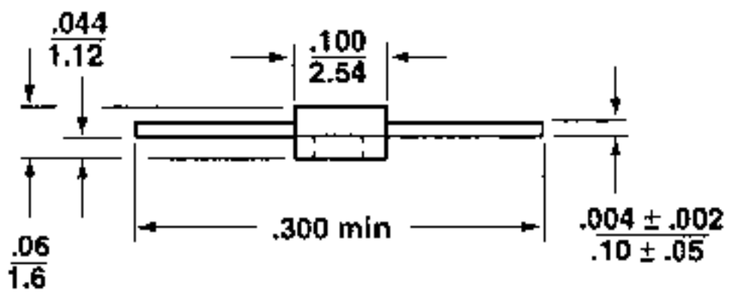
Typical Scattering Parameters, Common Emitter, $Z_O = 50\ \Omega$, $T_A = 25°C$, $V_{DS} = 9$ V, $I_{DS} = 125$ mA

Freq.	S_{11}		S_{21}			S_{12}			S_{22}	
GHz	Mag.	Ang.	dB	Mag.	Ang.	dB	Mag.	Ang.	Mag.	Ang.
1.0	.94	-56	12.8	4.37	135	-31.4	.027	52	.64	-28
2.0	.86	-101	10.7	3.41	98	-27.3	.043	30	.59	-56
3.0	.82	-131	8.4	2.64	71	-26.9	.045	18	.58	-79
4.0	.82	-152	6.7	2.16	48	-26.4	.048	9	.62	-98
5.0	.80	-173	5.4	1.86	26	-26.0	.050	-1	.63	-112
6.0	.79	165	4.3	1.64	5	-25.8	.051	-12	.65	-126
7.0	.78	143	3.1	1.43	-18	-25.4	.054	-24	.65	-145
8.0	.78	131	1.6	1.20	-36	-24.7	.058	-37	.70	-166
9.0	.77	123	0.3	1.03	-55	-23.9	.064	-40	.73	173
10.0	.76	118	-1.2	.87	-72	-23.1	.070	-52	.76	158
11.0	.67	104	-2.0	.79	-91	-22.6	.074	-57	.79	146
12.0	.60	86	-2.7	.73	-110	-21.2	.087	-66	.83	136
13.0	.54	71	-3.5	.67	-133	-19.7	.104	-79	.87	124
14.0	.50	64	-4.0	.63	-154	-15.9	.160	-99	.92	115

A model for this device is available in the DEVICE MODELS section.

100 mil Flange Package Dimensions





Notes:
(unless otherwise specified)
1. Dimensions are in / mm
2. Tolerances
   in .xxx = ± 0.005
   mm .xx = ± 0.13

Package marking code is 461

Agilent Technologies
Innovating the HP Way

2–8 GHz Medium Power Gallium Arsenide FET

Technical Data

ATF-44101

Features

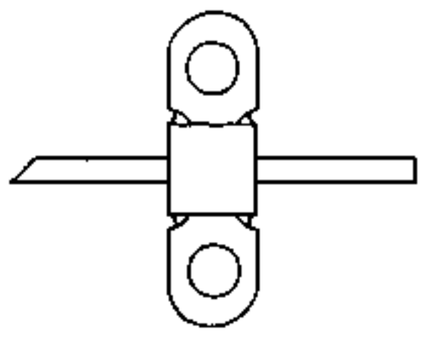
- **High Output Power:** 32.0 dBm Typical $P_{1\,dB}$ at 4 GHz
- **High Gain at 1 dB Compression:** 8.5 dB Typical $G_{1\,dB}$ at 4 GHz
- **High Power Efficiency:** 35% Typical at 4 GHz
- **Hermetic Metal-Ceramic Stripline Package**

Description

The ATF-44101 is a gallium arsenide Schottky-barrier-gate field effect transistor designed for medium power, linear amplification in the 2 to 8 GHz frequency range. This nominally .5 micron gate length GaAs FET is an interdigitated four-cell structure using airbridge interconnects between source fingers. Total gate periphery is 5 millimeters. Proven gold based metallization systems and nitride passivation assure a rugged, reliable device.

This device is suitable for applications in space, airborne, military ground and shipboard, and commercial environments. It is supplied in a hermetic high reliability package with low parasitic reactance and minimum thermal resistance.

100 mil Flange



Electrical Specifications, T_A = 25°C

Symbol	Parameters and Test Conditions		Units	Min.	Typ.	Max.
$P_{1\,dB}$	Power Output @ 1 dB Gain Compression: V_{DS} =9 V, I_{DS} = 500 mA	f = 4.0 GHz f = 6.0 GHz	dBm	31.0	32.0 31.5	
$G_{1\,dB}$	1 dB Compressed Gain: V_{DS} = 9 V, I_{DS} = 500 mA	f = 4.0 GHz f = 6.0 GHz	dB	7.5	8.5 5.5	
η_{add}	Efficiency @ P_{1dB}: V_{DS} = 9 V, I_{DS} = 500 mA	f = 4.0 GHz	%		35	
g_m	Transconductance: V_{DS} = 2.5 V, I_{DS} = 500 mA		mmho		300	
I_{DSS}	Saturated Drain Current: V_{DS} = 1.75 V, V_{GS} = 0 V		mA	800	1300	1500
V_p	Pinch-off Voltage: V_{DS} = 2.5 V, I_{DS} = 25 mA		V	-5.4	-4.0	-2.0

ATF-44101 Absolute Maximum Ratings

Symbol	Parameter	Units	Absolute Maximum[1]
V_{DS}	Drain-Source Voltage	V	+14
V_{GS}	Gate-Source Voltage	V	-7
V_{GD}	Gate-Drain Voltage	V	-16
I_{DS}	Drain Current	mA	I_{DSS}
P_T	Power Dissipation [2,3]	W	6.5
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175

Notes:
1. Permanent damage may occur if any of these limits are exceeded.
2. $T_{CASE\ TEMPERATURE}$ = 25°C.
3. Derate at 43 mW/°C for T_{CASE} > 25°C.
4. The small spot size of this technique results in a higher, though more accurate determination of θ_{jc} than do alternate methods. See MEASUREMENTS section for more information.

Thermal Resistance:	θ_{jc} = 23°C/W; T_{CH} = 150°C
Liquid Crystal Measurement:	1 µm Spot Size[4]

ATF-44101 Typical Performance, T_A = 25°C

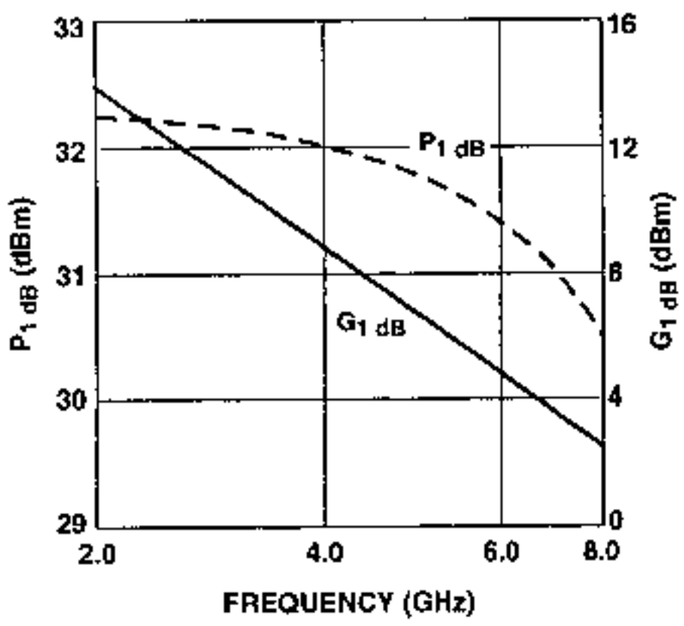


Figure 1. Power Output @ 1 dB Gain Compression and 1 dB Compressed Gain vs. Frequency.
V_{DS} = 9 V, I_{DS} = 500 mA.

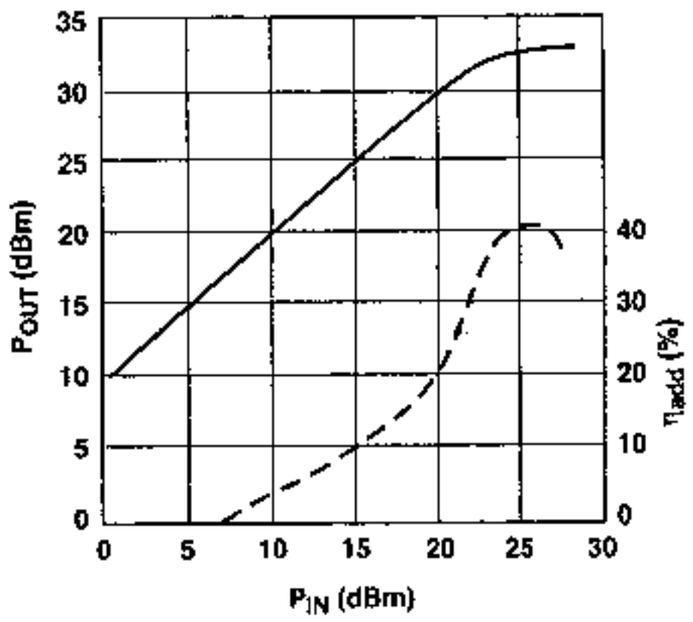


Figure 2. Output Power and Power Added Efficiency vs. Input Power.
V_{DS} = 9 V, I_{DS} = 500 mA, f = 4 GHz.

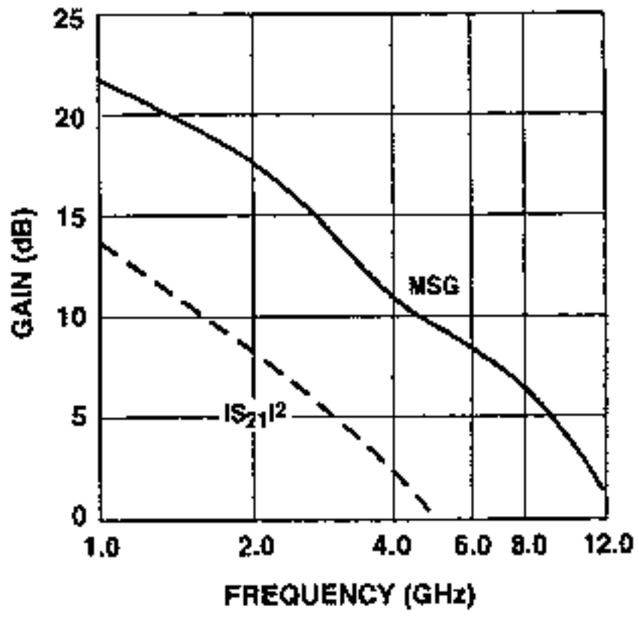


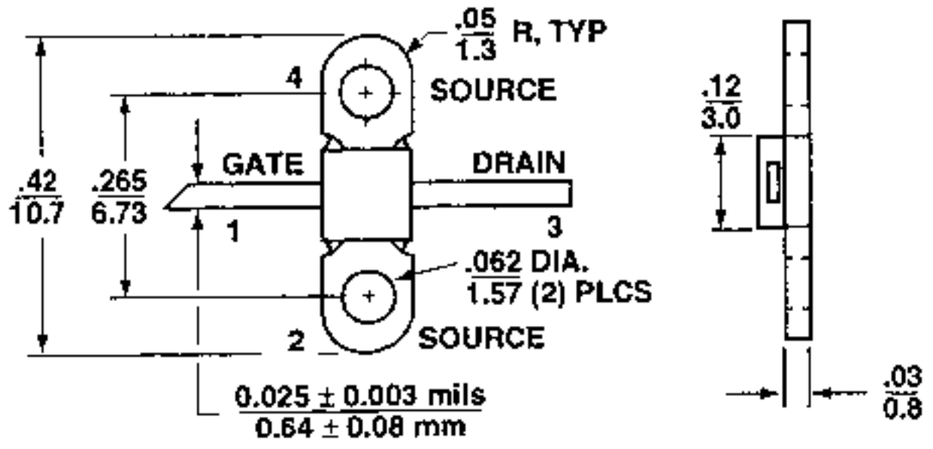
Figure 3. Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency.
V_{DS} = 9 V, I_{DS} = 500 mA.

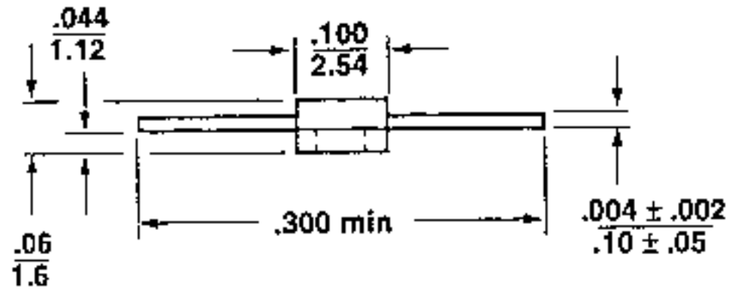
Typical Scattering Parameters, Common Emitter, Z_O = 50 Ω, T_A = 25°C, V_{DS} = 9 V, I_{DS} = 500 mA

Freq.	S_{11}		S_{21}			S_{12}			S_{22}	
GHz	Mag.	Ang.	dB	Mag.	Ang.	dB	Mag.	Ang.	Mag.	Ang.
1.0	.88	-125	13.4	4.69	104	-28.2	.039	31	.29	-154
2.0	.87	-161	8.1	2.53	74	-26.7	.046	21	.38	-164
3.0	.87	-178	4.8	1.73	54	-26.7	.046	22	.44	-167
4.0	.87	168	2.5	1.34	35	-25.7	.052	17	.47	-175
5.0	.88	153	0.8	1.10	16	-25.5	.053	13	.49	175
6.0	.88	136	-0.8	.91	-5	-23.6	.066	0	.52	160
7.0	.89	122	-2.5	.75	-25	-23.4	.068	-7	.56	144
8.0	.89	114	-4.2	.62	-39	-22.7	.073	-13	.62	132
9.0	.88	109	-5.5	.53	-52	-22.2	.078	-18	.68	124
10.0	.86	103	-6.7	.46	-64	-20.9	.090	-24	.72	118
11.0	.81	91	-6.9	.45	-78	-19.3	.108	-33	.73	112
12.0	.77	74	-7.5	.42	-95	-17.2	.138	-49	.73	101

A model for this device is available in the DEVICE MODELS section.

100 mil Flange Dimensions

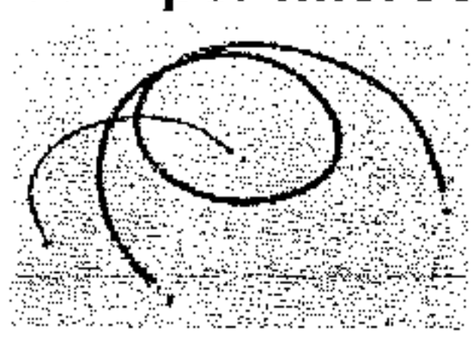




Notes:
(unless otherwise specified)
1. Dimensions are in / mm
2. Tolerances
   in .xxx = ± 0.005
   mm .xx = ± 0.13

Package marking code is 441

Cavi per microonde, serie ReadyFlex



Prestazioni garantite e piccole dimensioni caratterizzano questa alternativa ad alto rendimento rispetto ai cavi preassemblati coassiali RG e semirigidi. Si addicono a numerose applicazioni di laboratorio e di verifica in cui sono necessari connettori SMA.

Nota: tutti i cavi sono dotati a ciascuna estremità di connettori SMA maschio.

Modello	**145**	**195**
∅ cavo	3,9	5,4
Raggio di piegatura minimo	13,0	25,0
Perdita d'inserzione garantita (dB per cavi da 1 m)		
2 GHz	0,77	0,55
18 GHz	2,33	1,65

CONNETTORI SMA x MSTRIP → CAVO

Electrical Characteristics
Nominal Impedance--50 ohms
VSWR for Straight Connectors--1.15 + .01 (F in GHz)
VSWR for Right Angle Connectors--1.15 + .02 (F in GHz)
RF Leakage-- -60 db between 2-3 GHz
Dielectric Withstanding Voltage--1000 volts rms at 60 Hz
Contact Resistance--
Center Contact--3 mW
Right-Angle Contact--4 mW
Outer Contact--2 mW
Braid to Shell--0.5 mW
Insulation Resistance--
5000 MW min.
RF Insertion Loss--
Straight connector--.06√F(GHz) db max.
Right-Angle connector--.15√F(GHz) db max.

Environmental Characteristics
Temperature Range-- -65°C to +105°C
Vibration--Per MIL-STD-202, Method 204, Test Condition D
Shock--Per MIL-STD-202, Method 213, Test Condition I
Moisture Resistance--Per MIL-STD-202, Method 106
Corrosion--Per MIL-STD-202, Method 101, Test Condition B

Mechanical Characteristics
Cable Retention--40 lbs. (typical)
Mating/Unmating--Threaded coupling
Coupling Nut Retention--60 lbs. min.
Durability--500 cycles per MIL-C-39012

Mini bobine, formato 0603/0805/1206, 85/125°, SMD NUOVO

miniReel - Vishay - Vitramon

- Mini-bobine di condensatori SMD da 500 pezzi
- Per piccole produzioni, per prototipizzazione e laboratori di ricerca e sviluppo
- Con terminali nichelati

Specifiche tecniche			
Dielettrico	**NPO/COG**	**X7R**	**Z5U**
Tolleranza	±5%	±10%	±20%
Temp. di funz.	da -55°C a +125°C	da -55°C a +125°C	da +10°C a +85°C
Q.tà per bobina	500	500	500

Formato 0603/0805

Confezione da: 500 pezzi

Valore	Capacità	Codice	Prezzo/conf.	
0603, COG			*1-2*	*3-4*
50V	**10pF**	**254-1036**	**L.54,500**	**L.51,800**
50V	**22pF**	**254-1086**	**L.54,500**	**L.51,800**
0603, X7R				
25V	**0.1µF**	**254-1244**	**L.61,300**	**L.58,200**
0805, COG				
50V	**47pF**	**254-1367**	**L.50,200**	**L.47,700**
50V	**100pF**	**254-1418**	**L.50,200**	**L.47,700**
50V	**330pF**	**254-1468**	**L.51,600**	**L.49,000**
50V	**470pF**	**254-1474**	**L.51,600**	**L.49,000**
50V	**680pF**	**254-1480**	**L.58,200**	**L.55,300**
50V	**1,000pF**	**254-1496**	**L.58,200**	**L.55,300**
0805, X7R				
50V	**4,700pF**	**254-1525**	**L.38,700**	**L.36,700**
50V	**10,000pF**	**254-1531**	**L.38,700**	**L.36,700**
50V	**22,000pF**	**254-1547**	**L.46,100**	**L.43,800**
50V	**47,000pF**	**254-1553**	**L.58,200**	**L.55,300**
50V	**0.1µF**	**254-1575**	**L.56,200**	**L.53,400**
0805,Z5U				
50V	**0.1µF**	**254-1604**	**L.56,200**	**L.53,400**

Resistenze a film sottile, (SMD), di precisione, formato 0805

Meggitt Holsworthy

Serie RN

Serie E96 da 100R a 100K con tolleranza 0,1% 10ppm e valori E48 da 105K a 249K con tolleranza 0,5% 50ppm.
Questi resistori miniaturizzati di elevata precisione possiedono un duro rivestimento epossidico sopra l'elemento depositato di nichel-cromo ed uno strato barriera di nichel che conferiscono una durata più lunga dei terminali. Forniti su nastro da 8mm e marcati singolarmente con codici a 4 cifre.

Specifiche tecniche

	100R-100K	*105K-249K*	
Potenza nominale a 70°C	0,1W	0,1W	
Tolleranza sulla resistenza	±0,1%	±0,5 %	
Coefficiente di temperatura	±10ppm/°C	±50ppm/°C	
Temperatura di funzionamento	da –55°C a +125°C	da –55°C a +125°C	
Tensione di funzionamento max.	100V	100V	
Tensione di sovraccarico max.	200V	200V	
Dimensioni (mm)	Lungh.	Largh.	Spess.
	2,0	1,25	0,5