General Purpose 0.5 µm N-Type GaAs MESFET Transistors

MA4TF50 Series

V3.00

Features

- Low Noise Figure
- High Associated Gain
- High Maximum Available Gain
- Designed for Battery Operation
- Useful to Ku-Band

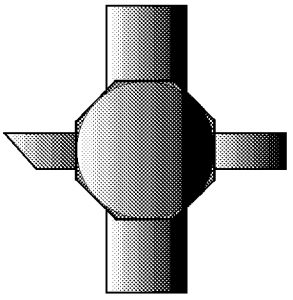
Description

The MA4TF50 is an n-type GaAs depletion mode Metal Semiconductor Field Effect Transistor (MESFET) series with a 0.5 micron gate length and a periphery of 300 microns. The device is available in the ceramic surface mount package, MA4TF5005, and in other hermetically sealed packages. It is also available as a chip, MA4TF5000, with the active region protected by a scratch resistant silicon nitride passivation layer.

Applications

The MA4TF50 series is intended for low cost commercial applications including low noise microwave amplifiers up to X-band and oscillators up to Ku-band. The low voltage and low current biasing requirement is attractive for battery operation.

Case Styles



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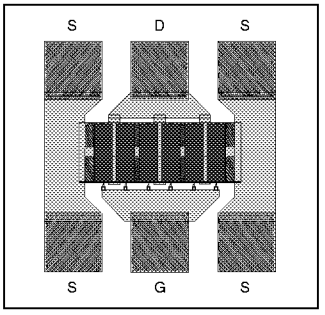

Chip

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MA4TF50 Series
Maximum Ratings

(Case Temperature 25°C Unless Otherwise Noted)

Parameter	Symbol	Maximum
Total Power Dissipation of Chip	P_d	300 mW
Total Power Dissipation Ceramic Surface Mount Package	P_d	250 mW
Drain to Source Voltage	V_{DS}	10 V
Gate to Drain Voltage	V_{GDO}	-16 V
Gate to Source Voltage	V_{GSO}	-16 V
Drain Current	I_{DS}	125 mA
Gate Current	I_{GS}	1 mA
Storage Temperature Range	T_S	-65°C to +175°C
Channel Temperature	T_{CH}	+175°C
Lead Temperature	T_L	230°C for 10 seconds

MA4TF5005 (Ceramic Surface Mount Package)
Electrical Specifications @ 25°C

Parameter	Condition	Symbol	Min	Typical	Max	Units
Saturated Drain to Source Current	V_{DS} = 3 V V_{GS} = 0 V	I_{DSS}	30	50	—	mA
Pinch-off Voltage	I_{DS} = 1% I_{DSS}	Vp	-0.5	-1.6	-2.5	V
Transconductance	V_{DS} = 3 V V_{GS} = 0 V	G_m	—	45	—	mS
Gate-Drain Breakdown Voltage	I_G = 10 µA	BV_{GDO}	-7	-14	—	V
Gate-Source Breakdown Voltage	I_G = 10 µA	BV_{GSO}	-7	-14	—	V
Gate-Source Leakage Current	V_{GS} = -5 V	I_{GSO}	—	—	10	µA
Thermal Resistance (Channel to Ambient)	—	R_{TH}	—	200	—	°C/W
Maximum Frequency of Oscillation	V_{DS} = 3 V I_{DS} = 10 mA	f_{MAX}	—	>60	—	GHz
Maximum Available Gain	V_{DS} = 3 V I_{DS} = 30 mA f = 4 GHz	MAG	—	16	—	dB
Optimum Noise Figure	V_{DS} = 3 V I_{DS} = 10 mA f = 4 GHz	NF_O	—	1.0	1.5	dB
Associated Gain	V_{DS} = 3 V I_{DS} = 10 mA f = 4 GHz	G_A	—	11.5	—	dB
Transducer Gain	V_{DS} = 3 V I_{DS} = 30 mA f = 4 GHz	$\|S_{21}\|^2$	4	8	—	dB
Power Output at 1 dB Compression	V_{DS} = 3 V I_{DS} = 30 mA f = 4 GHz	P_{1dB}	—	+16.0	—	dBm

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MA4TF5005
Typical Common Source Scattering Parameters in the Ceramic Surface Mount Package
V_{DS} = 3 V, I_{DS} = 10 mA

Frequency (GHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
0.50	1.02	-9.4	2.20	171.2	0.01	83.5	0.73	-6.2
1.00	1.02	-19.0	2.21	162.3	0.02	77.4	0.73	-12.5
1.50	1.01	-28.6	2.26	153.2	0.03	70.4	0.74	-19.5
2.00	0.97	-37.3	2.19	142.8	0.05	62.6	0.74	-25.5
2.50	0.95	-47.6	2.20	133.0	0.06	55.1	0.72	-32.3
3.00	0.93	-57.9	2.19	123.4	0.07	47.8	0.71	-39.1
3.50	0.91	-67.9	2.16	113.7	0.08	40.5	0.69	-45.9
4.00	0.88	-77.7	2.12	104.6	0.08	33.2	0.68	-52.0
4.50	0.86	-87.5	2.08	95.9	0.09	26.0	0.66	-57.8
5.00	0.83	-96.8	2.06	87.4	0.10	19.3	0.64	-63.3
5.50	0.81	-106.2	2.05	79.0	0.10	12.7	0.63	-69.0
6.00	0.78	-115.7	2.04	70.6	0.10	6.3	0.60	-74.7
6.50	0.75	-126.3	2.02	61.8	0.11	-0.3	0.58	-81.2
7.00	0.72	-136.8	2.00	52.7	0.11	-8.0	0.55	-87.6
7.50	0.70	-146.9	1.96	44.5	0.11	-13.6	0.53	-93.2
8.00	0.68	-157.1	1.94	36.4	0.11	-17.6	0.51	-99.1
8.50	0.68	-167.4	1.93	28.0	0.11	-20.9	0.50	-105.8
9.00	0.68	- 177.8	1.90	19.5	0.11	-25.3	0.49	-113.4
9.50	0.67	172.1	1.86	11.2	0.11	-30.2	0.48	-120.8
10.00	0.67	163.2	1.82	3.3	0.11	-34.5	0.47	-128.1
10.50	0.67	153.6	1.78	-4.5	0.11	-38.9	0.46	-136.0
11.00	0.68	144.1	1.75	- 12.6	0.11	-43.4	0.46	-143.8
11.50	0.68	134.5	1.70	-20.8	0.11	47.9	0.45	-152.1
12.00	0.69	125.4	1.66	-29.1	0.11	-52.0	0.44	-160.6
12.50	0.70	116.2	1.61	-37.4	0.10	-55.8	0.44	-169.9
13.00	0.70	107.7	1.55	-45.7	0.10	-59.1	0.43	-179.7
13.50	0.71	99.5	1.49	-53.7	0.10	-61.9	0.43	170.2
14.00	0.72	91.6	1.43	-61.5	0.09	-64.7	0.44	160.6
14.50	0.74	84.5	1.38	-69.0	0.09	-66.1	0.45	151.8
15.00	0.75	77.8	1.33	-76.3	0.09	-67.6	0.47	142.9
15.50	0.76	71.9	1.29	-83.5	0.09	-69.3	0.48	135.0
16.00	0.76	66.4	1.25	-90.6	0.09	-70.4	0.51	126.8
16.50	0.77	60.9	1.22	-97.9	0.09	-72.3	0.54	119.2
17.00	0.78	55.5	1.18	-105.2	0.09	-75.0	0.56	111.7
17.50	0.78	49.5	1.13	-112.6	0.09	-77.6	0.58	104.2
18.00	0.78	44.0	1.07	-119.8	0.09	-80.1	0.60	96.7
18.50	0.78	38.9	1.00	-126.3	0.09	-82.3	0.62	89.7
19.00	0.79	34.6	0.94	-132.5	0.09	-83.8	0.65	83.0
19.50	0.79	30.4	0.88	-138.1	0.09	-85.6	0.67	77.2
20.00	0.80	25.9	0.84	-143.7	0.09	-88.6	0.70	72.4

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Typical Common Source Scattering Parameters in the Ceramic Surface Mount Package (Cont'd)

V_{DS} = 3 V, I_{DS} = 30 mA

Frequency (GHz)	S_{11E}		S_{21E}		S_{12E}		S_{22E}	
	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
0.50	1.02	-10.9	3.12	170.4	0.01	83.0	0.73	-6.3
1.00	1.01	-22.1	3.15	160.6	0.02	76.3	0.73	-12.7
1.50	1.01	-33.3	3.18	150.6	0.03	69.2	0.73	-19.8
2.00	0.95	-43.4	3.06	139.7	0.04	61.1	0.73	-25.7
2.50	0.93	-55.1	3.04	129.2	0.05	53.4	0.71	-32.3
3.00	0.90	-66.6	2.98	119.1	0.05	46.0	0.69	-39.0
3.50	0.88	-77.7	2.91	109.2	0.06	38.7	0.68	-45.5
4.00	0.85	-88.5	2.82	99.8	0.07	31.8	0.66	-51.3
4.50	0.82	-99.1	2.75	90.8	0.07	24.9	0.64	-56.8
5.00	0.79	-109.4	2.68	82.3	0.07	18.5	0.62	-61.8
5.50	0.76	-119.7	2.63	73.6	0.07	12.5	0.605	-67.0
6.00	0.74	-130.1	2.59	65.2	0.07	6.8	0.58	-72.0
6.50	0.71	-141.5	2.54	56.4	0.08	0.9	0.56	-78.0
7.00	0.68	-152.8	2.47	47.4	0.07	-5.7	0.53	-83.7
7.50	0.66	-163.3	2.40	39.3	0.07	-9.2	0.51	-88.6
8.00	0.65	-173.5	2.36	31.5	0.07	-10.3	0.50	-94.1
8.50	0.65	176.2	2.32	23.3	0.07	-10.7	0.49	-100.4
9.00	0.66	166.0	2.27	15.0	0.07	-13.5	0.48	-107.6
9.50	0.66	156.5	2.21	7.0	0.07	-16.1	0.47	-114.7
10.00	0.66	147.9	2.15	-0.6	0.07	-18.4	0.47	-121.8
10.50	0.67	138.9	2.09	-8.2	0.07	-20.9	0.46	-129.5
11.00	0.68	130.0	2.04	-16.0	0.08	-23.3	0.46	-137.2
11.50	0.69	121.1	1.98	-23.9	0.08	-25.3	0.45	-145.2
12.00	0.70	112.6	1.92	-31.9	0.08	-27.1	0.45	-153.6
12.50	0.71	104.3	1.85	-39.9	0.08	-28.8	0.44	-162.9
13.00	0.72	96.6	1.78	-47.8	0.08	-30.4	0.44	-172.6
13.50	0.74	89.1	1.71	-55.5	0.08	-31.7	0.44	177.3
14.00	0.75	82.0	1.64	-63.1	0.08	-33.7	0.44	167.4
14.50	0.76	75.5	1.58	-70.4	0.09	-35.2	0.45	158.4
15.00	0.77	69.1	1.52	-77.6	0.09	-37.4	0.47	149.2
15.50	0.79	63.5	1.48	-84.7	0.09	-40.0	0.49	141.0
16.00	0.79	58.4	1.44	-91.8	0.10	-43.0	0.52	132.5
16.50	0.80	53.0	1.40	-99.2	0.10	-46.1	0.54	124.6
17.00	0.81	47.7	1.35	-106.5	0.11	-49.8	0.56	116.7
17.50	0.81	41.9	1.30	-113.8	0.11	-53.6	0.59	109.0
18.00	0.81	36.6	1.23	-120.9	0.11	-57.7	0.61	101.0
18.50	0.81	31.8	1.15	-127.5	0.11	-61.0	0.63	93.6
19.00	0.81	27.7	1.08	-133.6	0.11	-63.9	0.65	86.6
19.50	0.82	23.7	1.02	-139.1	0.11	-67.3	0.68	80.4
20.00	0.82	19.5	0.97	-144.8	0.11	-71.1	0.070	75.2

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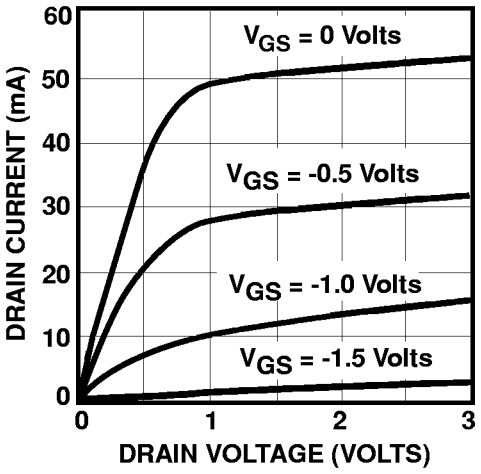
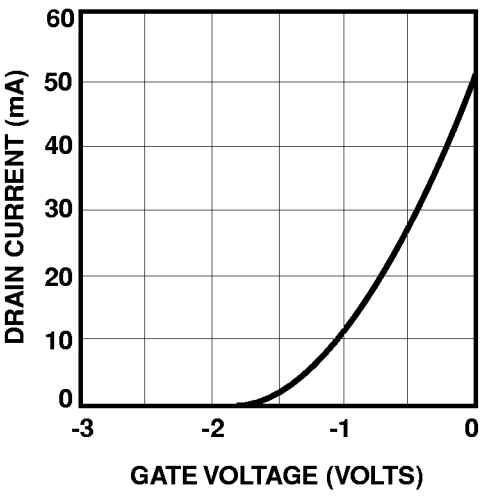
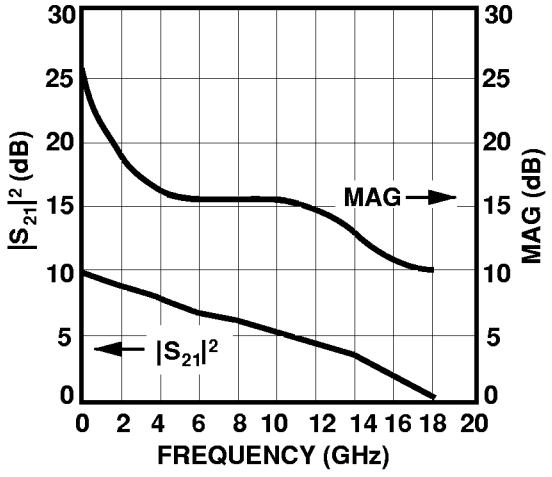
Typical Performance Curves @ 25°C



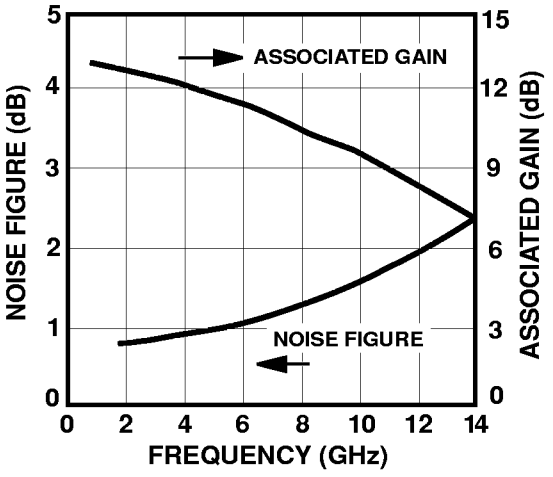
DRAIN CURRENT vs GATE VOLTAGE AT V_{DS} = 3 V



MAXIMUM AVAILABLE GAIN AND TRANSDUCER GAIN
V_{DS} = 3 V, I_{DS} = 30 mA

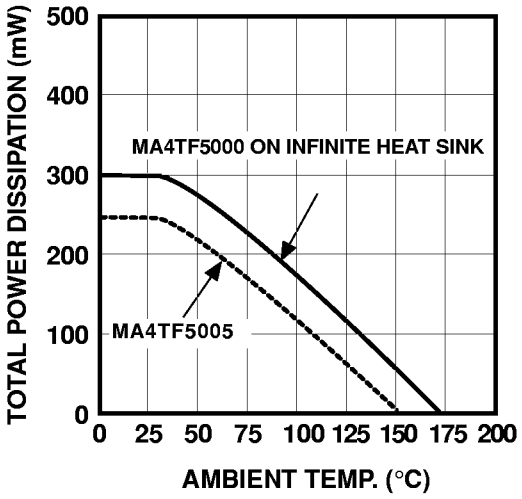


ASSOCIATED GAIN AND NOISE FIGURE vs FREQUENCY
V_{DS} = 3 V, IDS = 30 mA

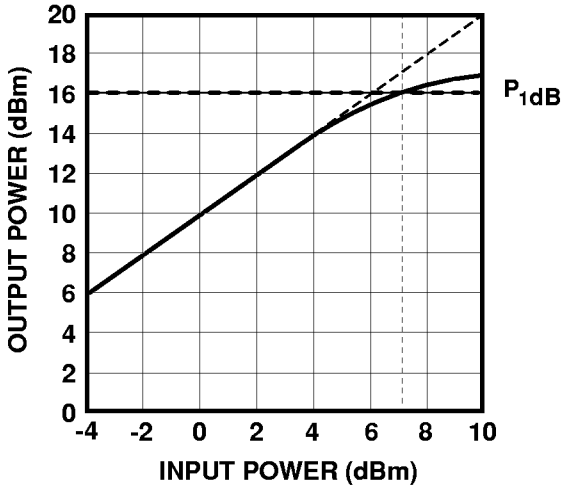


Typical Performance Curves (Cont'd)

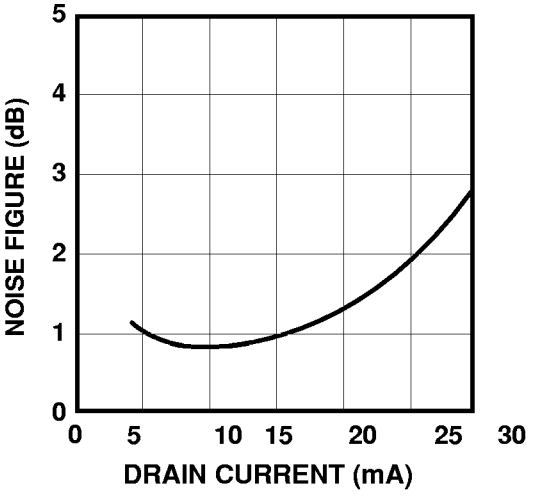
POWER DISSIPATION



OUTPUT POWER vs INPUT POWER
(P_{1DB} = 16 dBM)
V_{DS} = 3 V, I_{DS} = 30 mA, F = 4 GHz



NOISE FIGURE vs DRAIN CURRENT
V_{DS} = 3 V, F = 4 GHz



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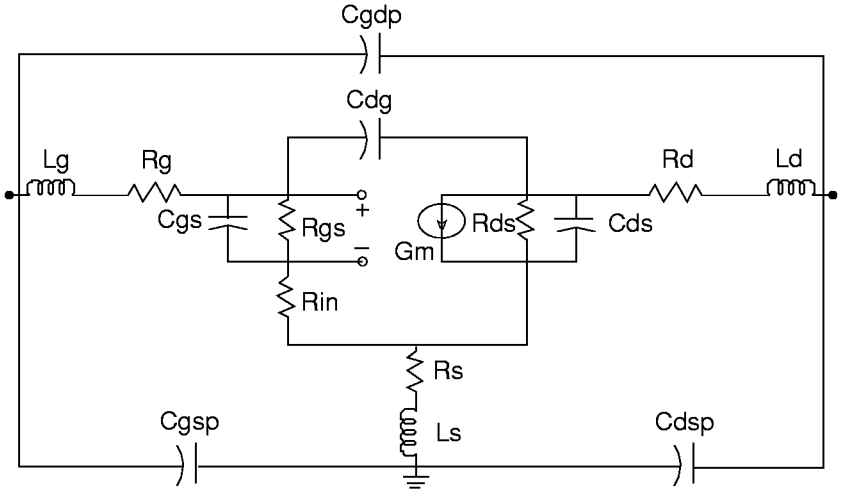
MA4TF5005 in the Ceramic Surface Mount Package
Typical Noise Parameters
V_{DS} = 3V, I_{DS} = 10 mA

Frequency (GHz)	NF_O (dB)	G_A (dB)	Γ_{OPT}		R_n
			Mag	Angle	
2.00	0.68	14.41	0.73	28.1	22.29
3.00	0.84	12.88	0.71	43.3	25.24
4.00	1.00	11.55	0.69	60.8	25.74
5.00	1.16	10.41	0.67	80.3	23.48
6.00	1.32	9.43	0.65	101.4	18.77
7.00	1.48	8.62	0.63	123.5	12.74
8.00	1.64	7.96	0.62	146.4	7.16
9.00	1.81	7.44	0.60	169.5	3.93
10.00	1.97	7.06	0.60	-167.5	4.61
11.00	2.13	6.81	0.60	-145.1	9.94
12.00	2.29	6.67	0.60	-123.7	19.75
13.00	2.45	6.65	0.61	-103.7	33.12
14.00	2.61	6.71	0.63	-85.6	48.79

MA4TF5005 in the Ceramic Surface Mount Package
Small Signal Model
V_{DS} = 3V, I_{DS} = 10 mA



Element	Value
Rg	0.18 Ω
Rd	0.0015 Ω
Rs	5.5 Ω
Rin	5.0 Ω
Rgs	1481 Ω
Rds	406 Ω
Cgs	0.35 pF
Cds	0.16 pF
Cdg	0.055 pF

Element	Value
Gm	32 mS
Tau	8.62 ps
Lg	0.60 nH
Ld	0.59 nH
Ls	0.045 nH
Cgsp	0.065 pF
Cgdp	0.019 pF
Cdsp	0.039 pF

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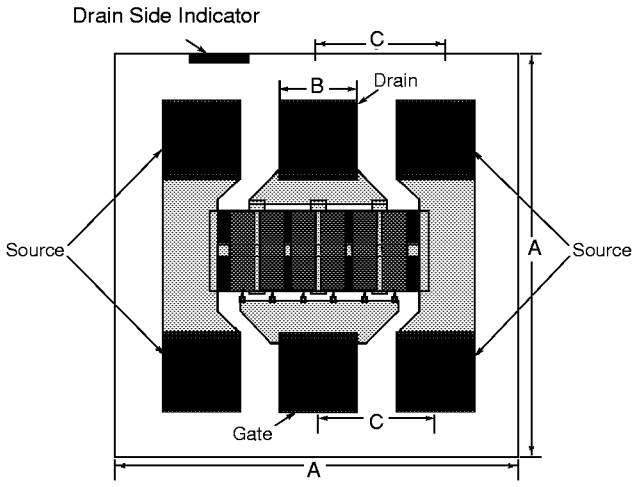
Chip – MA4TF5000

Case Style 1161

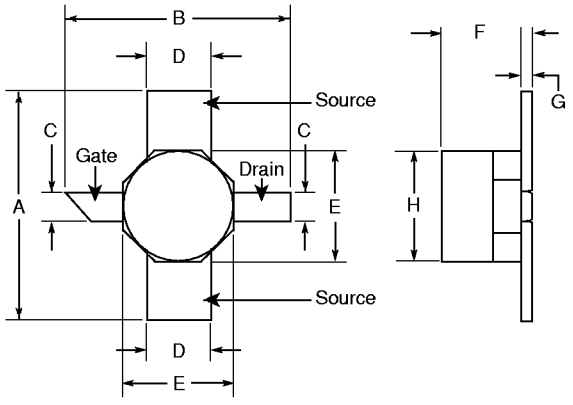


MA4TF5000

DIM.	INCHES (NOM.)	MILLIMETERS (NOM.)
A	0.016	0.406
B	0.002	0.050
C	0.003	0.075

Ceramic Surface Mount Package

Case Style 1105 — MA4TF5005



MA4TF5005

DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX
A	0.150	0.165	3.80	4.20
B	0.150	0.165	3.80	4.20
C	0.014	0.026	0.35	0.65
D	0.032	0.047	0.80	1.20
E	0.063	0.079	1.60	2.00
F	—	0.057	—	1.45
G	0.002	0.008	0.05	0.20
H	0.063	0.079	1.60	2.00

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