Advanced Product Information
January 2005 V1.0 *(1 of 7)*

0.1 GHz to 6.0 GHz InGaP HBT, MMIC or Packaged, Matched Gain Block Amplifier

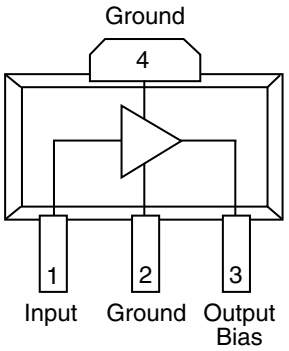
Features

- ❑ **Low Operating Voltage: 5V**
- ❑ **33.8 dBm Output IP3** @ 850 MHz
- ❑ **3.3 dB Noise Figure** @ 850 MHz
- ❑ **23.1 dB Gain** @ 850 MHz, **19.5 dB** @ 6 GHz
- ❑ **18.2 dBm P1dB** @ 850 MHz
- ❑ **Low Performance Variation Over Temperature**
- ❑ **Low Cost: Die Form or SOT-89 Package**
- ❑ **100% DC On-Wafer Testing**
- ❑ **ESD Protection on All Die: >1000V HBM**
- ❑ **Low Thermal Resistance: <100°C/Watt**

Applications

- ❑ **PA Driver Amp, IF Amp, LO Buffer Amp**
- ❑ **Cellular, PCS, GSM, UMTS, WiMAX**
- ❑ **Wireless Data and SATCOM**
- ❑ **Transmit and Receive Functions**

Functional Block Diagram (SOT-89)



Description

The CGB7017-SC (-BD) is a **Darlington Configured**, high dynamic range, utility gain block amplifier. Designed for applications operating within the 0.1 GHz to 6.0 GHz frequency range, Celeritek's broadband, cascadable, gain block amplifiers are ideal solutions for transmit, receive and IF applications.

These MMIC amplifiers are available in bare die form or an industry standard SOT-89 package. The CGB7017-SC (-BD) is fabricated in **Celeritek's in-house foundry**. Celeritek's InGaP HBT technology and an industry low thermal resistance offers a thermally robust and reliable gain block solution.

The InGaP HBT die have extra pads to enable thorough DC testing. This unique test capability and the inclusion of ESD protection on all die, significantly enhances the quality, reliability and ruggedness of these products.

With a single bypass capacitor, optional RF choke and two DC blocking capacitors, this gain block amplifier offers significant ease of use in a broad range of applications. In addition, flat gain across the full 2 to 6 GHz frequency band can be accomplished by simple adjustment of the output power match.

Electrical Characteristics

Unless otherwise specified, the following specifications are guaranteed at room temperature in a Celeritek test fixture.

		850 MHz			1950 MHz			2400 MHz			3500 MHz			6000 MHz			
Parameter	**Temperature (°C)**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Small Signal Gain	+25 -40 to +85	22.1 22.0	23.1 23.1	24.1 24.2	21.0 20.9	22.0 22.0	23.0 23.1	20.8 20.7	21.8 21.8	22.8 22.9		21.0 21.0			19.5 19.5		dB dB
Output P1dB	+25 -40 to +85	17.2 16.9	18.2 18.2		16.7 16.3	17.7 17.7		16.7 16.3	17.7 17.7			17.0 17.0			12.0 12.0		dBm dBm
Output IP3	+25 -40 to +85	32.3 31.8	33.8 33.8		31.4 30.9	32.9 32.9		30.2 29.7	31.7 31.7			27.6 27.6			20.3 20.3		dBm dBm
Noise Figure	+25 -40 to +85		3.3 3.3	4.1 4.5		3.6 3.6	4.4 4.8		3.7 3.7	4.5 4.9		3.8 3.8			4.6 4.6		dB dB
Operating Current	+25 -40 to +85	65 59	70 70	75 79	65 59	70 70	75 79	65 59	70 70	75 79		70 70			70 70		mA mA
Input Return Loss	+25 -40 to +85	11 10	15 15		11 10	16 16		11 10	15 15			11 11			7.5 7.5		dB dB
Output Return Loss	+25 -40 to +85	16 15	23 23		11 10	16 16		11 10	16 16			16 16			13 13		dB dB
Pout @ -45 dBc ACP, IS-95, 9 Forward Channels	+25 -40 to +85		12 12			12 12											dBm dBm

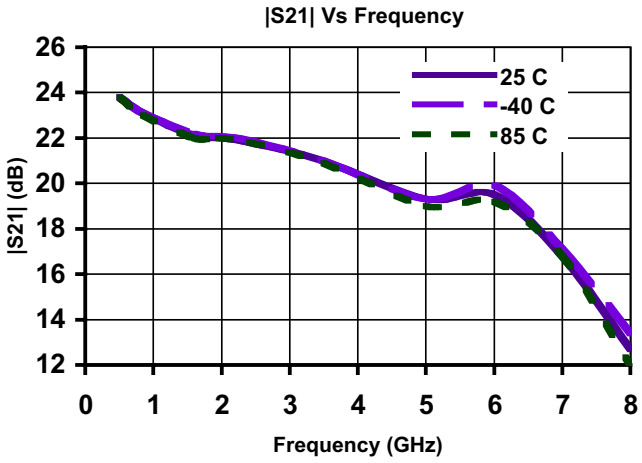
Notes: 1. Test Conditions in Celeritek eval board, Vs = 5 V, Id = 70 mA Typ., Rbias = 10 Ω, Zs = Zl = 50Ω, OIP3 tone spacing = 1 MHz, Pout per tone = 6 dBm.
2. Values reflect performance in recommended application circuit.

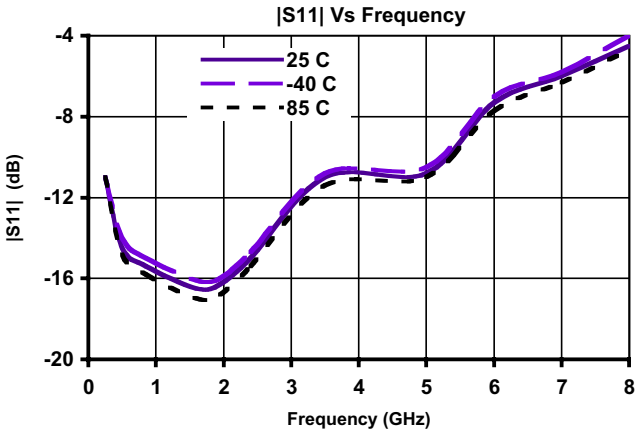
Absolute Maximum Ratings

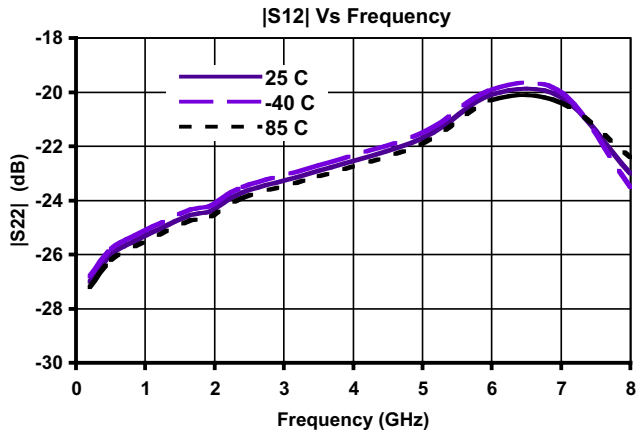
Operation of this device above any of these parameters may cause damage.

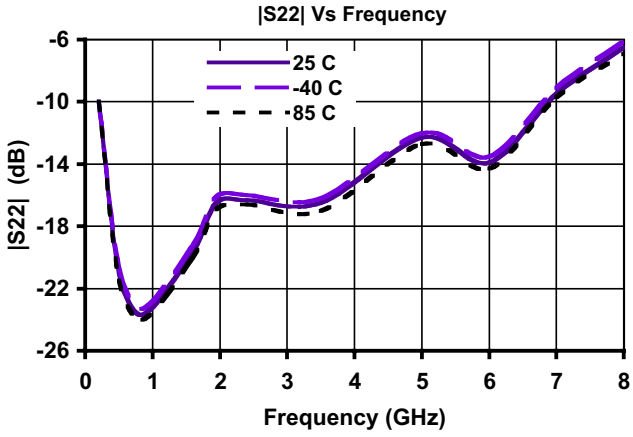
Parameter	Rating	Parameter	Rating	Parameter	Rating
Max Device Voltage	+6.0 V	RF Input Power	+17 dBm	Operating Temperature	-40°C to +85°C
Max Device Current	130 mA	Storage Temperature	-55°C to +150°C	Thermal Resistance	100°C/W
Max Device Dissipated Pwr	0.65 W	Junction Temperature	150°C	ESD (HBM)	1000 V

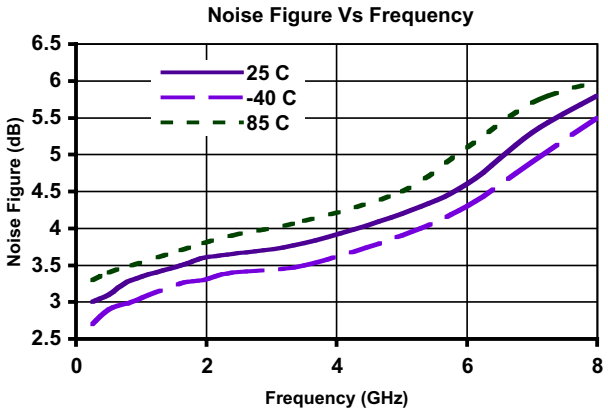
Typical S-Parameter and Noise Performance



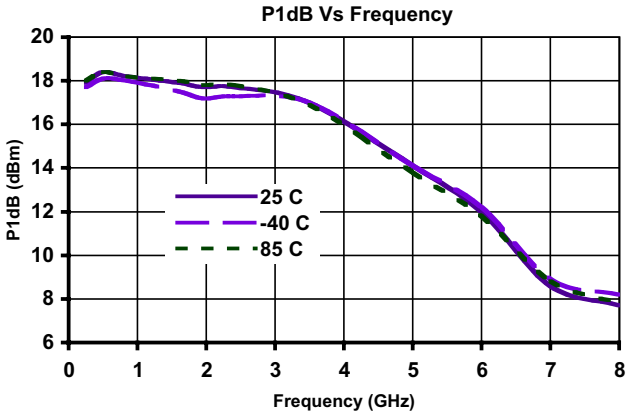


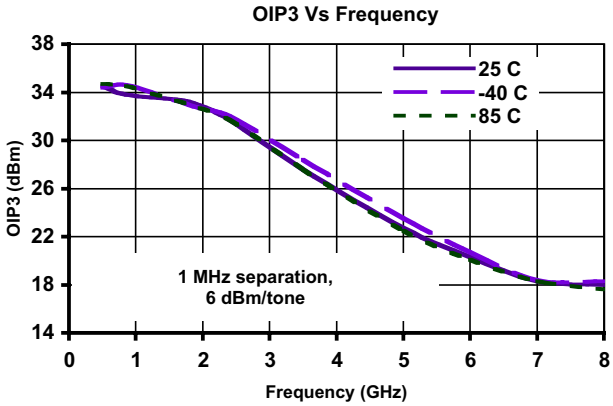




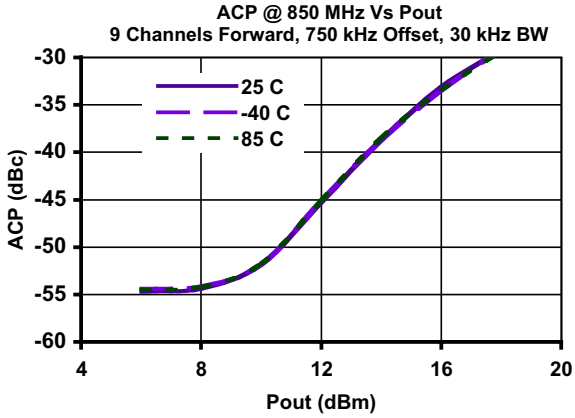


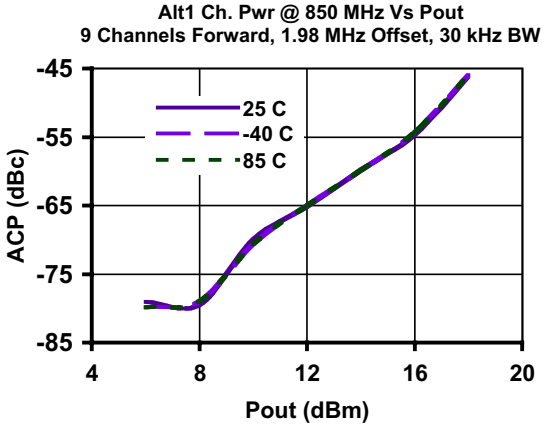
Typical Power and Linearity Performance

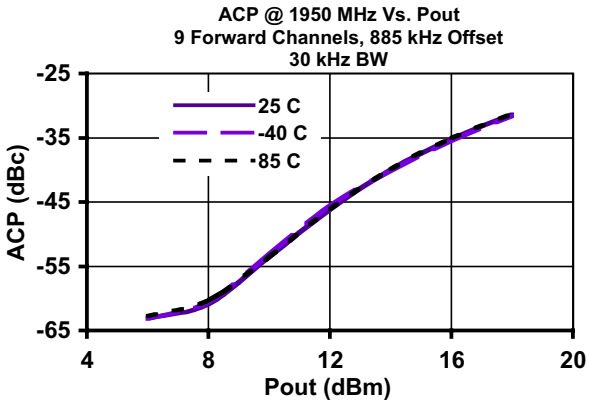


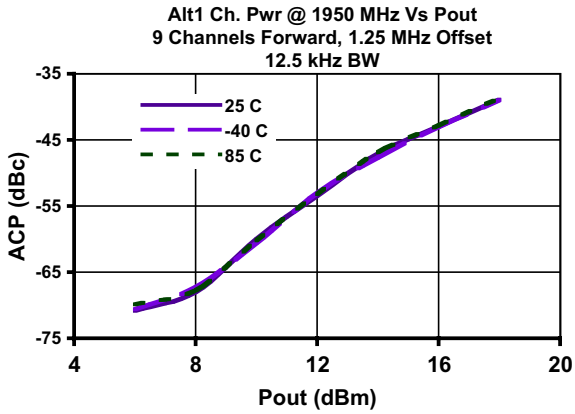


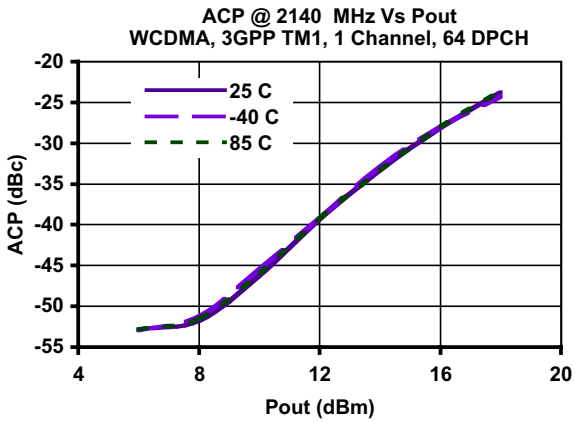
Linearity Performance - Base Station ACP – IS-95

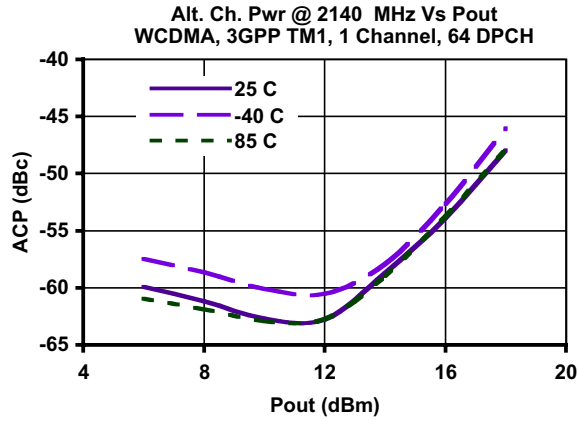












Typical Scattering Parameters (Vd = +4.5V, Icc = 74 mA, T = 23°C, device in a 50 ohm system)

Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	(Mag)	(Ang)	(Mag)	(Ang)	(Mag)	(Ang)	(Mag)	(Ang)
100	0.039	-164	15.58	175	0.054	-1	0.017	-130
200	0.043	-152	15.51	170	0.055	-2	0.026	-124
300	0.051	-144	15.45	164	0.055	-4	0.036	-120
400	0.058	-140	15.37	159	0.055	-5	0.046	-119
500	0.066	-136	15.27	154	0.055	-6	0.055	-119
600	0.075	-134	15.17	149	0.055	-7	0.065	-120
700	0.084	-134	15.06	144	0.055	-8	0.074	-122
800	0.094	-134	14.93	139	0.056	-10	0.083	-123
900	0.103	-134	14.81	134	0.056	-11	0.092	-124
1000	0.113	-134	14.68	130	0.057	-12	0.101	-126
1100	0.122	-135	14.54	125	0.057	-14	0.109	-128
1200	0.131	-136	14.40	120	0.057	-15	0.116	-130
1300	0.140	-137	14.25	115	0.058	-16	0.123	-132
1400	0.148	-139	14.08	110	0.059	-18	0.130	-134
1500	0.156	-140	13.93	106	0.059	-19	0.137	-136
1600	0.164	-142	13.77	101	0.060	-21	0.143	-138
1700	0.172	-144	13.61	96	0.060	-22	0.149	-140
1800	0.181	-145	13.44	92	0.061	-24	0.155	-142
1900	0.190	-147	13.28	87	0.062	-25	0.160	-144
2000	0.197	-149	13.12	83	0.062	-27	0.166	-146
2100	0.204	-151	12.96	78	0.063	-29	0.171	-147
2200	0.211	-153	12.80	74	0.064	-30	0.177	-149
2300	0.218	-155	12.64	69	0.065	-32	0.180	-151
2400	0.225	-157	12.49	65	0.065	-34	0.185	-153
2500	0.231	-159	12.33	60	0.066	-36	0.190	-154
2600	0.237	-162	12.19	56	0.067	-37	0.194	-156
2700	0.243	-164	12.04	52	0.068	-39	0.199	-158
2800	0.248	-167	11.89	47	0.069	-41	0.203	-160
2900	0.254	-169	11.75	43	0.070	-43	0.206	-162
3000	0.260	-171	11.61	39	0.070	-45	0.211	-163
3100	0.265	-173	11.49	35	0.072	-47	0.216	-165
3200	0.269	-176	11.38	31	0.073	-49	0.222	-167
3300	0.274	-179	11.27	26	0.074	-51	0.227	-169
3400	0.279	178	11.17	22	0.075	-53	0.231	-171
3500	0.285	175	11.07	18	0.076	-55	0.236	-173
3600	0.289	173	10.97	14	0.077	-57	0.242	-175
3700	0.293	169	10.89	10	0.078	-59	0.248	-178
3800	0.296	166	10.81	6	0.079	-61	0.254	179
3900	0.299	162	10.73	1	0.080	-64	0.259	176
4000	0.303	159	10.66	-3	0.082	-66	0.264	174
4100	0.306	155	10.58	-7	0.083	-68	0.268	171
4200	0.307	151	10.52	-11	0.084	-70	0.274	168
4300	0.308	147	10.46	-15	0.086	-73	0.279	164
4400	0.309	142	10.42	-20	0.087	-75	0.283	160
4500	0.310	138	10.36	-24	0.089	-78	0.287	157
4600	0.312	133	10.32	-28	0.090	-80	0.292	153
4700	0.313	128	10.28	-33	0.091	-83	0.297	149
4800	0.312	122	10.24	-37	0.093	-86	0.302	145
4900	0.313	117	10.22	-41	0.095	-89	0.307	140
5000	0.314	110	10.19	-46	0.096	-91	0.311	135

Continues Next Page. **S-Parameter Data Files are available on-line at: www.celeritek.com**

Typical Scattering Parameters - Continued (Vd = +4.5V, Icc = 74 mA, T = 23°C, device in a 50 ohm system)

Frequency	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	(Mag)	(Ang)	(Mag)	(Ang)	(Mag)	(Ang)	(Mag)	(Ang)
5100	0.315	104	10.15	-51	0.098	-94	0.314	130
5200	0.316	97	10.13	-55	0.100	-97	0.319	125
5300	0.317	91	10.11	-60	0.101	-100	0.324	120
5400	0.319	83	10.08	-65	0.103	-104	0.330	114
5500	0.323	75	10.05	-69	0.105	-107	0.335	108
5600	0.329	67	10.03	-74	0.106	-110	0.341	101
5700	0.337	59	9.99	-79	0.108	-114	0.347	95
5800	0.346	51	9.96	-84	0.109	-117	0.354	88
5900	0.355	42	9.90	-90	0.110	-121	0.361	81
6000	0.367	33	9.84	-95	0.112	-125	0.369	73
6100	0.384	24	9.76	-100	0.113	-129	0.378	66
6200	0.401	15	9.66	-106	0.113	-133	0.386	58
6300	0.420	7	9.56	-111	0.114	-137	0.397	51
6400	0.441	-2	9.43	-117	0.115	-141	0.408	43
6500	0.463	-10	9.29	-123	0.115	-145	0.421	35
6600	0.487	-19	9.13	-128	0.114	-149	0.435	27
6700	0.513	-26	8.93	-134	0.114	-153	0.448	19
6800	0.537	-34	8.73	-140	0.113	-158	0.462	12
6900	0.561	-42	8.50	-145	0.112	-162	0.477	4
7000	0.586	-49	8.27	-151	0.110	-166	0.492	-3
7100	0.609	-56	8.00	-157	0.109	-170	0.505	-11
7200	0.632	-63	7.72	-162	0.106	-174	0.518	-18
7300	0.652	-70	7.44	-168	0.104	-178	0.531	-25
7400	0.670	-76	7.17	-173	0.102	178	0.542	-31
7500	0.688	-82	6.88	-178	0.099	174	0.554	-38
7600	0.703	-88	6.59	176	0.096	170	0.565	-44
7700	0.718	-94	6.31	171	0.094	167	0.575	-49
7800	0.730	-99	6.02	166	0.091	163	0.584	-55
7900	0.741	-104	5.76	162	0.089	160	0.592	-60
8000	0.749	-109	5.50	157	0.086	157	0.599	-65
8100	0.757	-114	5.24	152	0.083	153	0.607	-70
8200	0.766	-119	5.00	148	0.081	151	0.613	-75
8300	0.772	-123	4.75	144	0.078	148	0.619	-80
8400	0.776	-128	4.53	139	0.076	145	0.625	-84
8500	0.779	-132	4.33	135	0.074	142	0.629	-88
8600	0.782	-136	4.13	131	0.072	139	0.633	-92
8700	0.783	-140	3.93	127	0.069	137	0.638	-95
8800	0.786	-144	3.75	123	0.067	134	0.642	-99
8900	0.787	-147	3.58	120	0.065	132	0.644	-103
9000	0.786	-151	3.42	116	0.064	130	0.647	-106
9100	0.785	-155	3.27	112	0.062	128	0.650	-109
9200	0.784	-158	3.13	109	0.060	126	0.652	-112
9300	0.783	-162	2.99	105	0.059	123	0.654	-115
9400	0.781	-165	2.86	102	0.057	121	0.656	-118
9500	0.777	-168	2.74	98	0.056	119	0.658	-121
9600	0.773	-171	2.62	95	0.055	117	0.660	-124
9700	0.769	-175	2.51	91	0.054	115	0.661	-127
9800	0.765	-178	2.41	88	0.053	113	0.663	-129
9900	0.762	179	2.31	85	0.052	112	0.664	-132
10000	0.756	176	2.21	81	0.051	110	0.665	-134

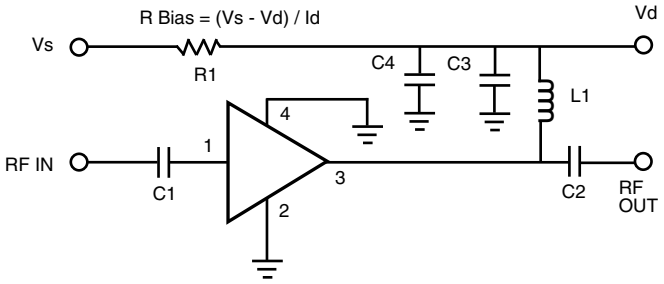
S-Parameter Data Files are available on-line at: www.celeritek.com

Application Circuit

Note: This schematic represents the topology of the application circuit recommended by Celeritek.

Recommended Bias Resistor Values for ID = 78 mA				
Supply Voltage (V)	5V	7V	8V	10V
Rbias (R1 Description: 1206 1/4W 1%)	10Ω	38Ω	—	—
Rbias (R1 Description: 1210 1/2W 1%)	—	—	52Ω	81Ω

Note: Rbias provides DC bias stability over temperature.

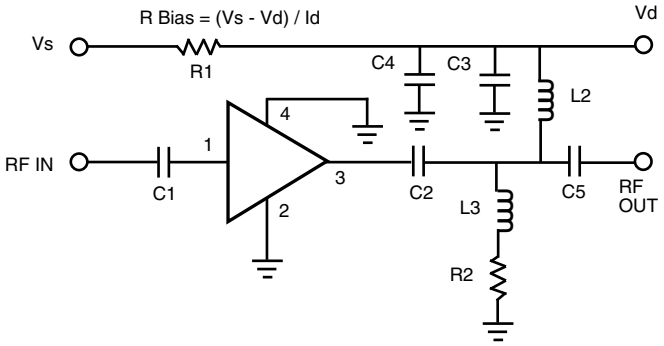


Application Circuit for Flat Gain @ 2 to 6 GHz

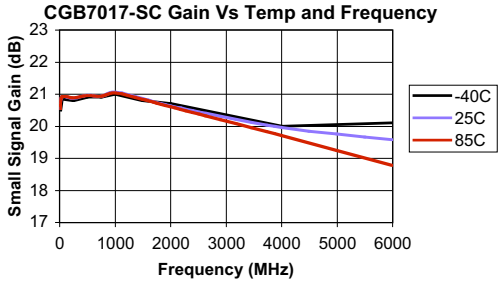
Note: This schematic represents the topology of the application circuit recommended by Celeritek.

Recommended Bias Resistor Values for ID = 78 mA				
Supply Voltage (V)	5V	7V	8V	10V
Rbias (R1 Description: 1206 1/4W 1%)	10Ω	38Ω	—	—
Rbias (R1 Description: 1210 1/2W 1%)	—	—	52Ω	81Ω

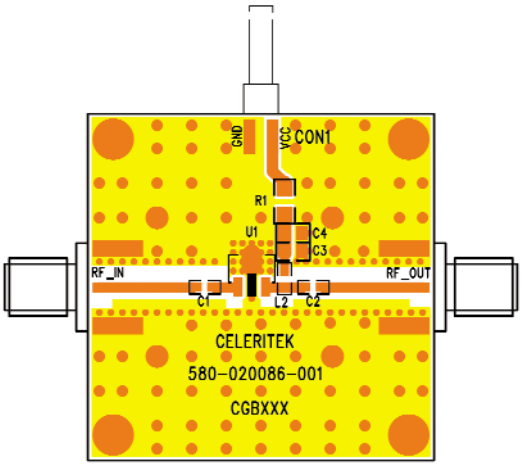
Note: Rbias provides DC bias stability over temperature.



Typical Gain Performance



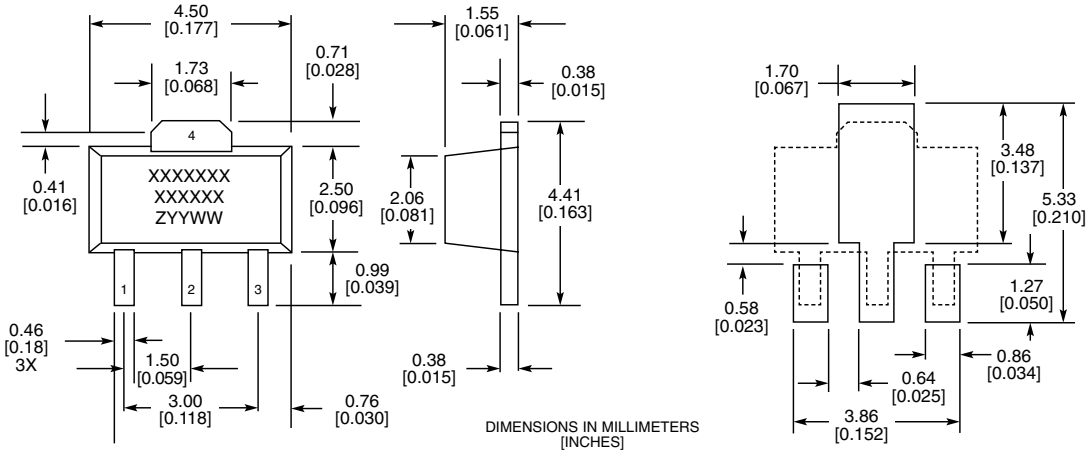
Evaluation Board SC Package (SOT-89)



Ref Designator	Value	Description	Size
C1, C2, C3	1000 pF	MCH185A101JK	0805
C4	1.0 µF	VITR 1.0 µF 25V CER CAP 0805 X7R 10%	0805
L1	56 nH	Coilcraft 0603 CS 10%	0603
L2	470 nH	Coilcraft 0805 CS 10%	0805
L3	6.8 nH	Coilcraft 0603 CS 10%	0603
R1		R Bias = (Vs - Vd) / Id	1206 / 1210
R2	75Ω	1206 1/4W	1206
C4		DNP (Do Not Place)	N/A

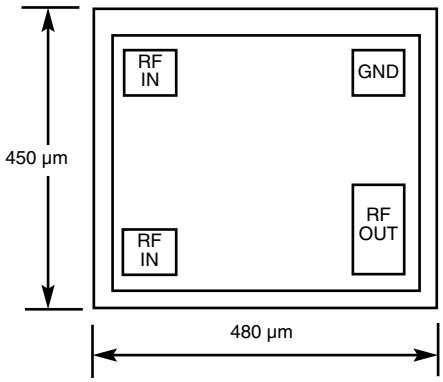
Note: Contact factory for matching recommendations if flat gain is required from 2 to 6 GHz.

Physical Dimensions - SC Package (SOT-89)



MARKINGS:
XXXXXXX = CELERITEK MODEL NO.
XXXXXX = WAFER LOT NO.
ZYYWW = DATE CODE (YR/WEEK)
FIRST LETTER COUNTRY OF ORIGIN IF OTHER THAT USA

Physical Dimensions - BD (Bare Die)



Notes:
RF OUT bonding pad is 75 µm x 155 µm.
All other pads are 75 µm x 75 µm.

Caution: ESD Sensitive
Appropriate precautions in handling, packaging and testing devices must be observed.

Ordering Information

The CGB7000 family of cascadable gain block amplifiers are available in bare die form or in a SOT-89 package

Part Number for Ordering	Package
CGB7017-BD	**Bare die in GelPak**
CGB7017-SC	**SOT-89 Surface mount package in tube or tape and reel**
PB-CGB7017-SC	**Evaluation Board with SMA connectors for CGB7017-SC**

For your local distributor: Richardson Electronics-Worldwide, Phone: 1-800-737-6937 or www.rfwireless.rell.com