Application Note

CGO869
Application Note

AN10202

Philips Semiconductors

PHILIPS

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Abstract

The CGO869 is an optical receiver intended for HFC CATV network applications. In this report the main application for the CGO869 has been given as well as several typical measurement data of this device.

Revision history

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Application Note

CGO869

AN10202

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Summary

The CGO869 is an optical receiver, intended for HFC CATV network applications. Compared to the existing optical receivers of Philips Semiconductors, this optical receiver has:

- an 8dB higher responsivity; a specified response of 2000V/W instead of 800V/W.
- an improved EIN of max 6.5 instead of 8 pA/√Hz
- an improved S22 of min 16dB instead of 11dB
- an integrated gain control, to vary the responsivity from 2000 to 900 V/W, by applying 0 to 24V respectively, to pin 6.
- the distortion levels of CGO869 (d2 and d3) are equal to those of the BGO847 at the same Vout.

In this report, the main application for the CGO869 has been given, as well as several typical measurement data of this device.

Contents

1. INTRODUCTION

The CGO869 is an optical receiver, intended for HFC CATV network applications. Compared to the existing optical receivers of Philips Semiconductors, this optical receiver has:

- an 8dB higher responsivity; a specified response of 2000V/W instead of 800V/W.
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- an improved S22 of min 16dB instead of 11dB
- an integrated gain control, to vary the responsivity from 2000 to 900 V/W, by applying 0 to 24V respectively, to pin 6.
- the distortion levels of CGO869 (d2 and d3) are equal to those of the BGO847 at the same Vout.

In this report, the main application for the CGO869 has been given, as well as several typical measurement data of this device.

2. MAIN APPLICATION

The CGO869 has been designed for HFC systems where the optical signal of 1 optical transmitter is split towards several optical receivers. The optical receiver, which receives the lowest optical signal is the limiting device for the overall system. At this receiver, the gain of the CGO869 is set to maximum, which results in a given Vout together with a certain d3, d2 and C/N ratio. At all the other CGO869 optical receivers, the gain control is being set such that the Vout is equal to the Vout of the first receiver. The CGO869 has been designed such that in this case, so at an equal Vout, the d3, d2 and C/N ratio is equal for all the CGO869 devices. The distribution amplifiers following these receivers can be designed equal because they have all the same input signal.
On the next page, a schematic diagram has been given with an example of the different distortion levels

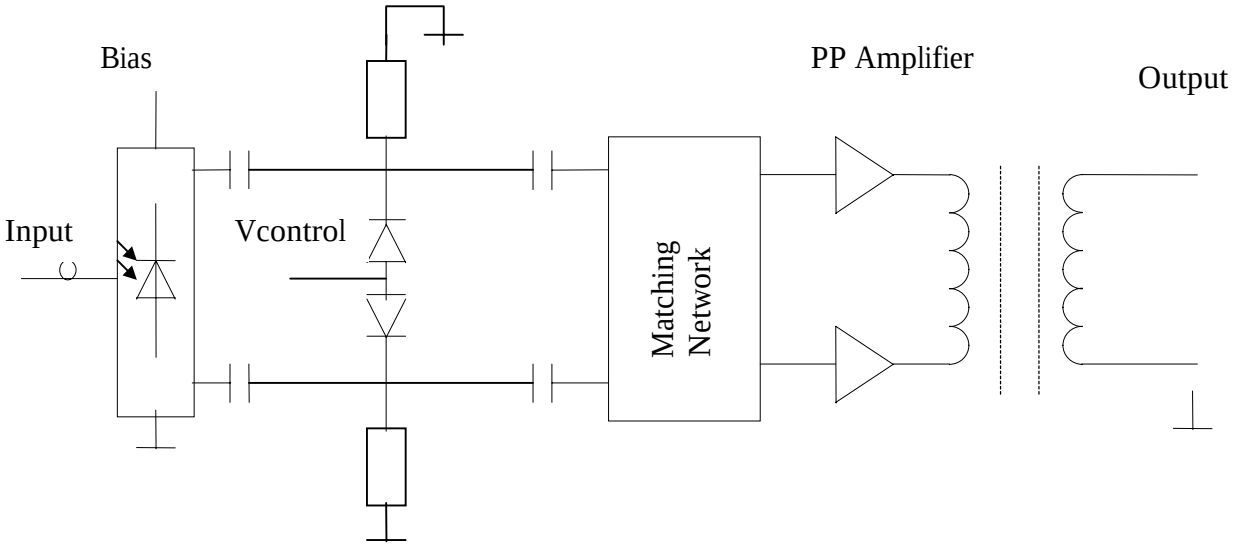
Reference documents:

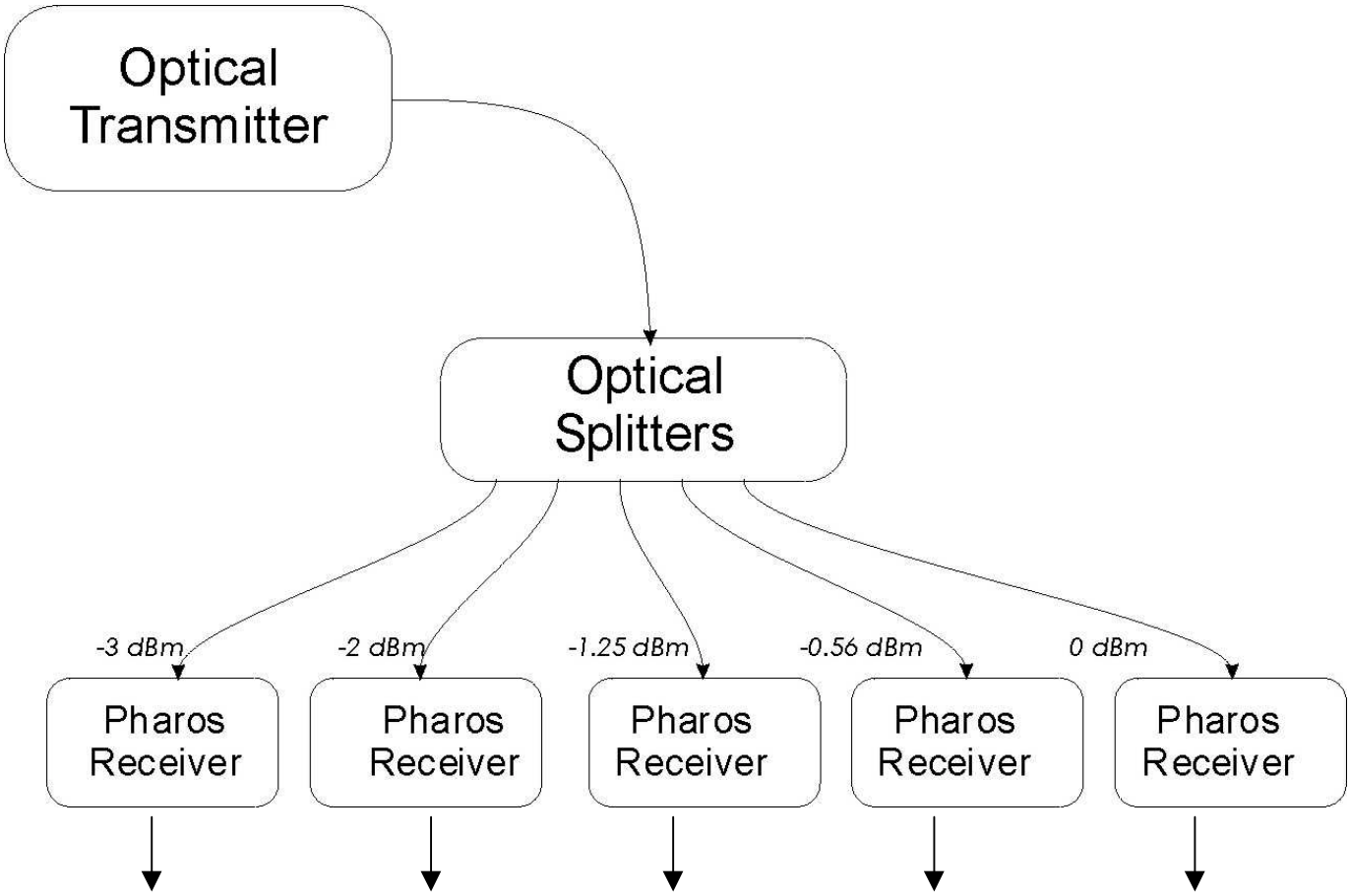
1. data sheet “CGO869; CGO869/SC0, 870MHz optical receiver with integrated gain control”
2. application note “AN98060, Using a Philips optical receiver in CATV applications”.

Both mentioned documents also be found on the internet:
http://www.semiconductors.philips.com/catalog/219/282/30926/30905/index.html#30905

3. CIRCUIT DIAGRAM

The circuit diagram of the CGO869 is given on the diagram below.

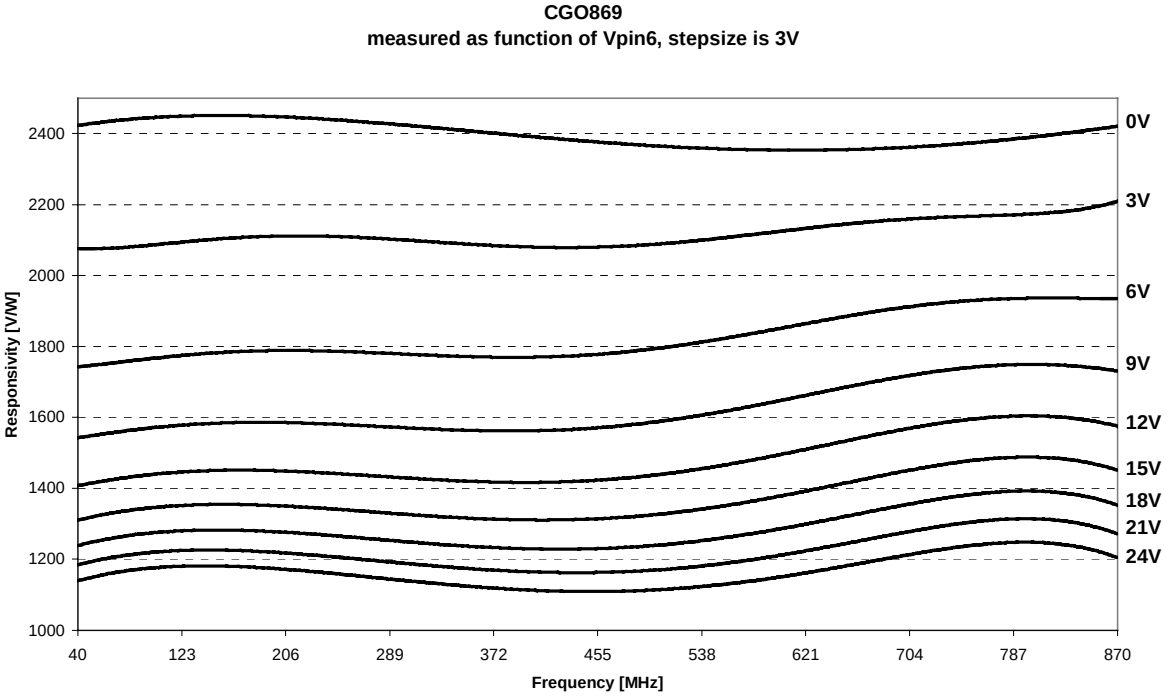




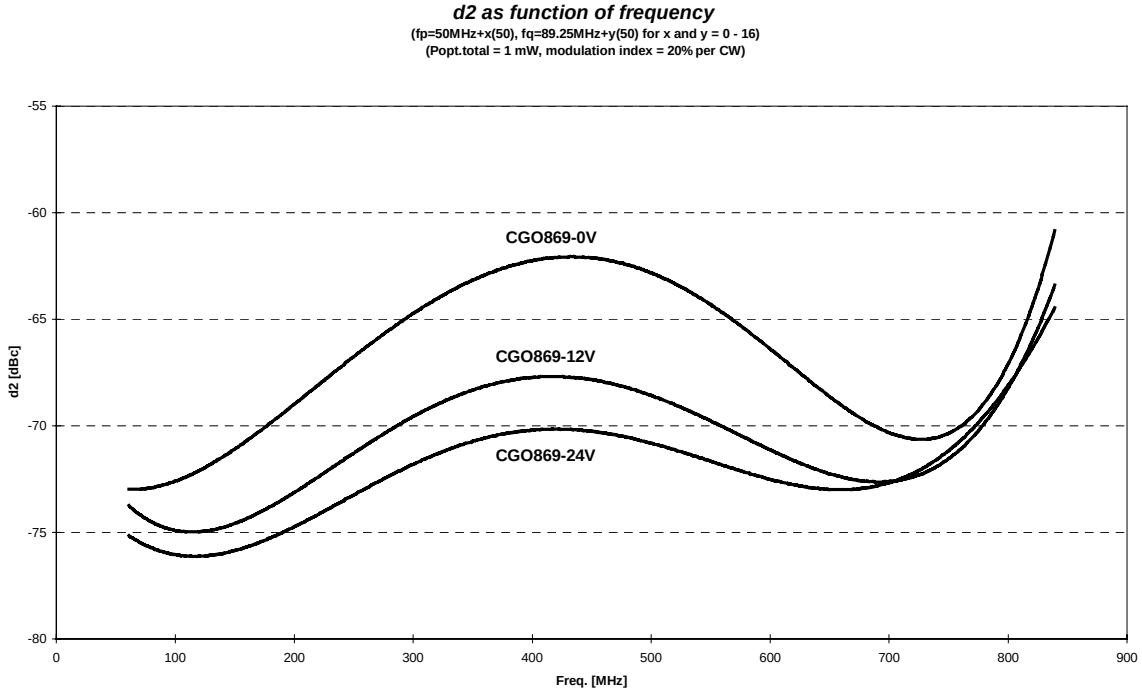
Popt-in	Optical input power	[dBm]	-3		-2		-1.25	-0.56		0
	Optical input power	[mW]	0.5		0.63		0.75	0.88		1
Vgc-in	Gain control voltage setting	[V]	0		± 4		± 7.5	± 12		± 24
RF-out	Output voltage	[dBmV]	29		29		29	29		29
CNR	Carrier to noise ratio (minimum)	[dB]	51		51		51.1	51.3		51.5
d2	Second order distortion (minimum)	[dB]	-61		-61		-61	-61		-61
d3	Third order distortion (minimum	[dB]	-69		-69		-69	-69		-69

4. PERFORMANCE

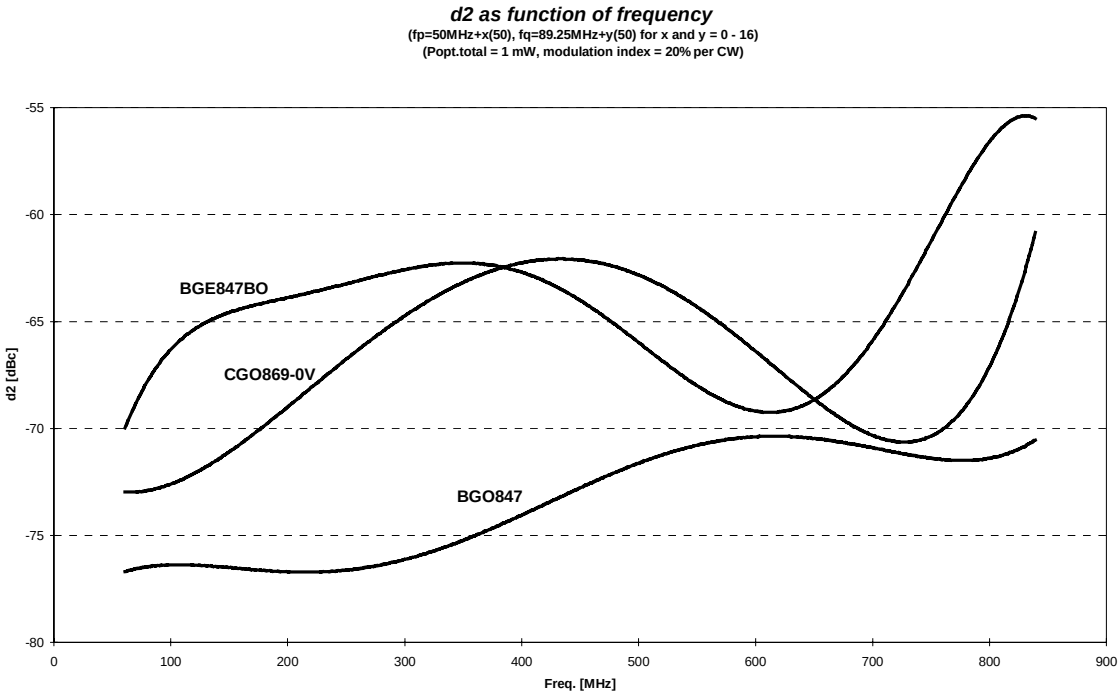
Responsivity of the CGO869 at different gain control settings



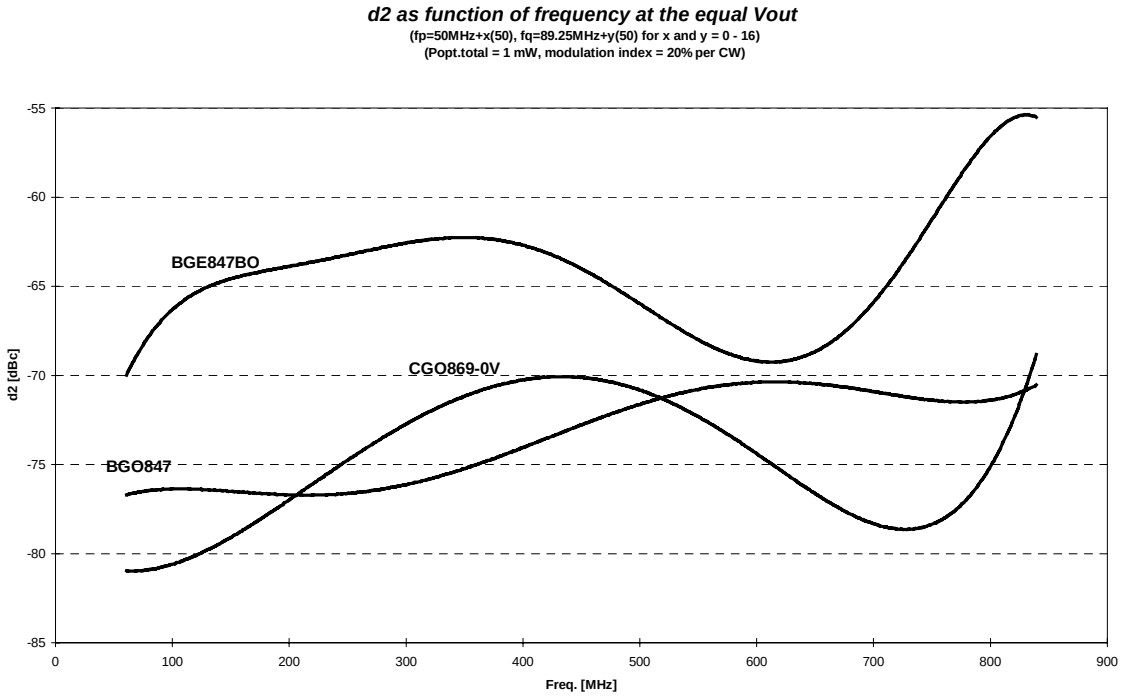
Second order distortion versus frequency of the CGO869 at different gain control settings total $P_{optical\ in}$ = 1mW



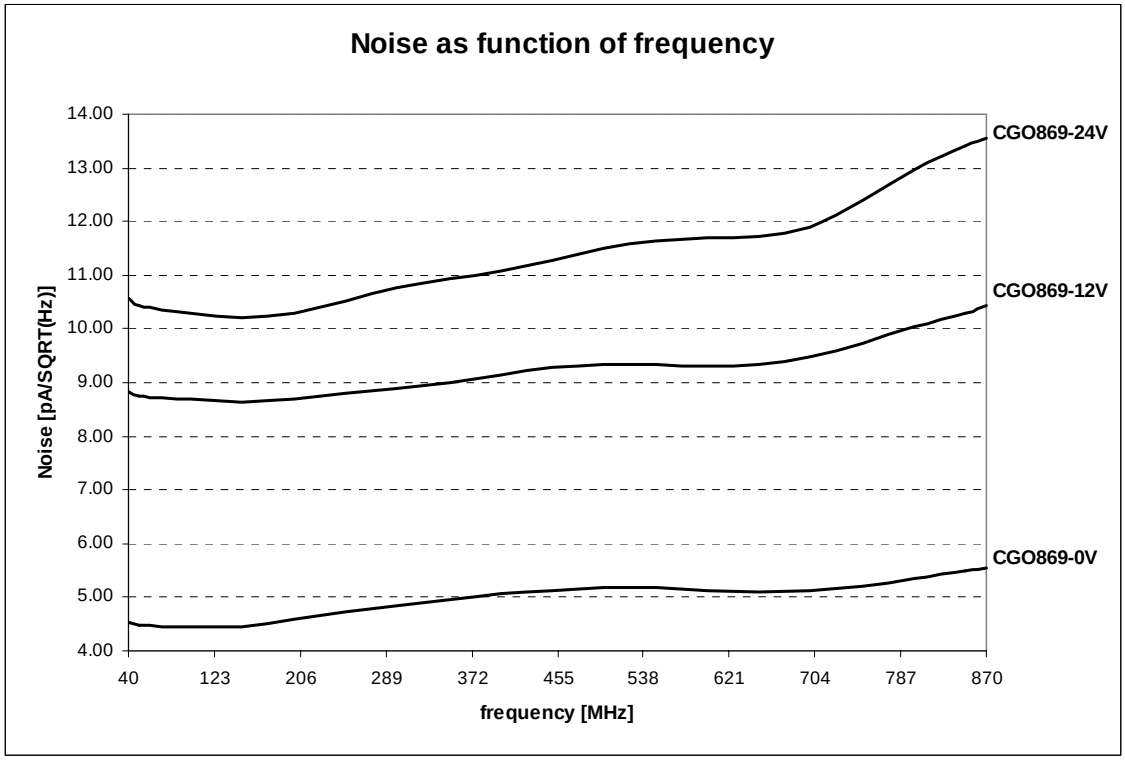
Second order distortion versus frequency of the CGO869, BGO847 and BGE847BO



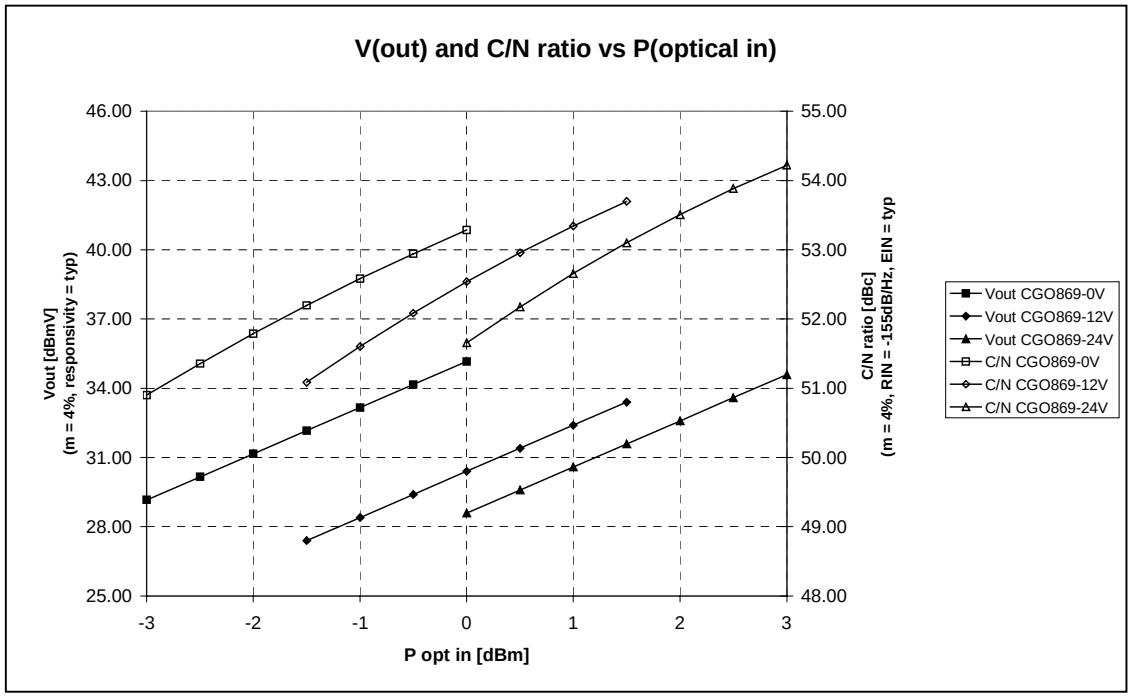
Second order distortion versus frequency of the CGO869, BGO847 and BGE847BO at equal output voltage



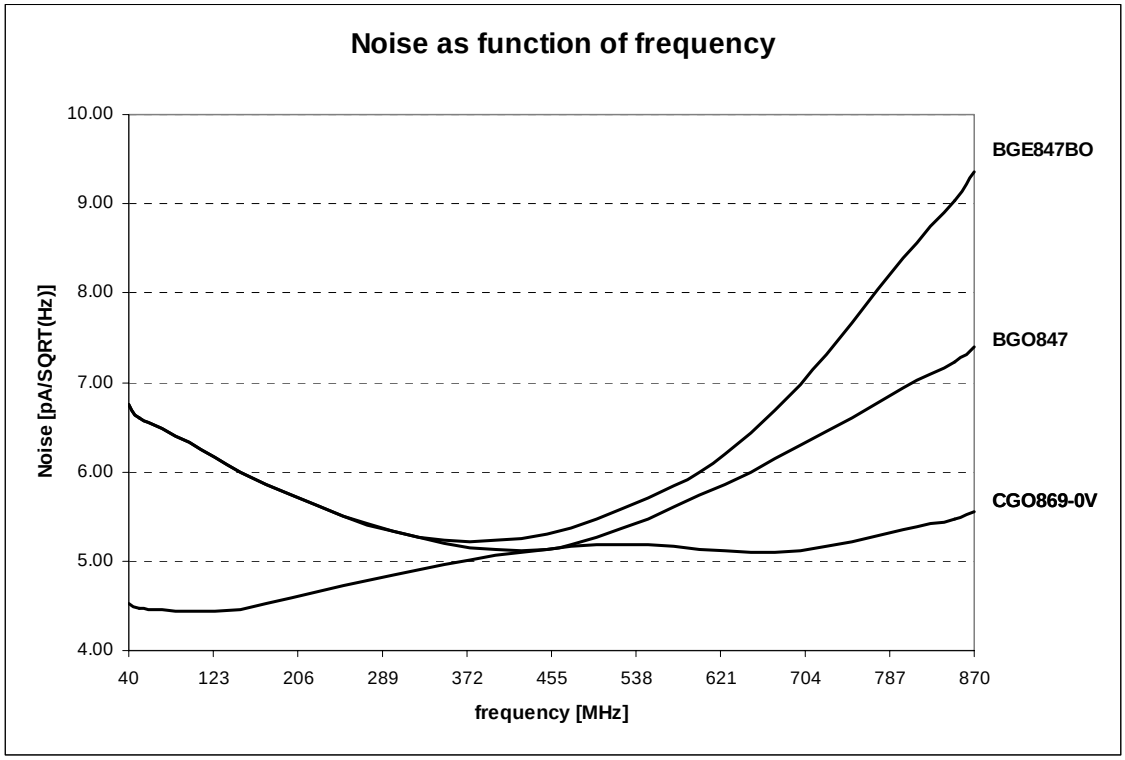
The equivalent input noise of the CGO869 at different gain control settings



The output voltage and carrier to noise ratio of the CGO869 at different gain control settings



The equivalent input noise of the CGO869, BGE847BO and BGO847



5. TEMPERATURE BEHAVIOUR

Pharos made on EE4 with Vpin6 = 0V
measured at -20, 30 and 85°C

Delta's versus temperature

		average values			worst case values	
		-20 - 30	85 - 30	85 - 30 [dB]	-20 - 30	85 - 30
responsivity @ 40MHz	[V/W]	38	-125	-0.50	108	-175
responsivity @ 50MHz	[V/W]	32	-134	-0.54	99	-176
responsivity @ 870MHz	[V/W]	98	-150	-0.59	191	-209
Flatness	[dB]	0.24	0.03		0.49	-0.20
Slope	[dB]	0.29	-0.14		0.40	-0.27
S22 40 - 80MHz	[dB]	-0.5	0.7		-0.9	1.0
S22 80 - 160MHz	[dB]	-1.2	0.8		-1.7	1.1
S22 160 - 320MHz	[dB]	-0.1	0.2		0.9	0.6
S22 320 - 640MHz	[dB]	-1.1	0.8		-1.5	0.8
S22 640 - 870MHz	[dB]	-0.9	1.6		-1.2	1.9
Vp_1	[V/mW]	-0.02	0.00		-0.06	0.02
Current	[mA]	-8	4		-9	5
d2 @ 54MHz	[dB]	-1.6	1.7		-0.5	2.4
d2 @ 746.5MHz	[dB]	-2.1	1.0		-1.3	2.0
d2 @ 854.5MHz	[dB]	-2.7	1.7		-1.3	3.1
d3 @ 445.25MHz	[dB]	-2.0	1.9		-0.9	2.4
d3 @ 745.25MHz	[dB]	-3.6	2.4		-3.4	3.2
d3 @ 853.25MHz	[dB]	-3.7	2.9		-3.2	3.5
EIN @ 40MHz	[pA/SQRT(Hz)]	-0.4	0.8		-0.6	0.9
EIN @ 750MHz	[pA/SQRT(Hz)]	-0.7	0.6		-0.7	0.7
EIN @ 870MHz	[pA/SQRT(Hz)]	-0.8	0.6		-0.8	0.7

Averages versus temperature

		-20°C	30°C	85°C	spec
responsivity @ 40MHz	[V/W]	2267	2229	2104	
responsivity @ 50MHz	[V/W]	2254	2223	2089	
responsivity @ 870MHz	[V/W]	2370	2272	2122	
Flatness	[dB]	0.79	0.55	0.58	
Slope	[dB]	0.47	0.18	0.03	
S22 40 - 80MHz	[dB]	-24.6	-24.1	-23.4	
S22 80 - 160MHz	[dB]	-25.2	-24.0	-23.2	
S22 160 - 320MHz	[dB]	-23.6	-23.5	-23.3	
S22 320 - 640MHz	[dB]	-19.9	-18.8	-18.0	
S22 640 - 870MHz	[dB]	-19.2	-18.3	-16.7	
Vp_1	[V/mW]	0.82	0.84	0.85	
Current	[mA]	195	203	207	
d2 @ 54MHz	[dB]	-79.3	-77.6	-75.9	-68
d2 @ 746.5MHz	[dB]	-67.9	-65.9	-64.8	-58
d2 @ 854.5MHz	[dB]	-64.7	-62.0	-60.3	-55
d3 @ 445.25MHz	[dB]	-70.6	-68.6	-66.8	-62
d3 @ 745.25MHz	[dB]	-69.4	-65.5	-63.0	-61
d3 @ 853.25MHz	[dB]	-66.4	-62.3	-59.4	-57
EIN @ 40MHz	[pA/SQRT(Hz)]	4.7	5.1	5.9	5
EIN @ 750MHz	[pA/SQRT(Hz)]	4.7	5.4	5.9	5.5
EIN @ 870MHz	[pA/SQRT(Hz)]	5.5	6.2	6.8	6.5

Pharos made on EE4 with Vpin6 = 12V measured at -20, 30 and 85°C

Delta's versus temperature

		average values				worst case values	
		-20 - 30	85 - 30	85 - 30 [dB]		-20 - 30	85 - 30
responsivity @ 40MHz	[V/W]	-36	-32	-0.22		-77	-55
responsivity @ 50MHz	[V/W]	-40	-34	-0.22		-71	-62
responsivity @ 870MHz	[V/W]	30	-89	-0.55		93	-123
Flatness	[dB]	-0.08	0.18			-0.26	0.23
Slope	[dB]	0.50	-0.34			0.63	-0.45
S22 40 - 80MHz	[dB]	-0.4	0.1			-0.7	0.4
S22 80 - 160MHz	[dB]	-0.6	0.3			-0.8	0.5
S22 160 - 320MHz	[dB]	-0.6	0.2			-1.1	0.5
S22 320 - 640MHz	[dB]	-2.1	1.0			-2.5	1.5
S22 640 - 870MHz	[dB]	-0.8	1.1			-1.2	1.7
Vp_1	[V/mW]	-0.02	0.01			-0.06	0.03
Current	[mA]	-8	5			-8	5
d2 @ 54MHz	[dB]	-3.9	3.4			-0.6	5.1
d2 @ 746.5MHz	[dB]	-2.7	1.6			-2.3	2.7
d2 @ 854.5MHz	[dB]	-3.0	2.1			-1.9	3.6
d3 @ 445.25MHz	[dB]	-3.7	2.6			-2.3	4.1
d3 @ 745.25MHz	[dB]	-4.4	3.0			-2.8	4.0
d3 @ 853.25MHz	[dB]	-4.1	3.7			-3.6	4.3
EIN @ 40MHz	[pA/SQRT(Hz)]	-0.5	0.5			-1.0	0.8
EIN @ 750MHz	[pA/SQRT(Hz)]	-0.5	0.5			-0.7	0.7
EIN @ 870MHz	[pA/SQRT(Hz)]	-0.8	0.6			-1.4	0.9

Averages versus temperature

		-20°C	30°C	85°C	spec
responsivity @ 40MHz	[V/W]	1264	1300	1268	
responsivity @ 50MHz	[V/W]	1273	1313	1280	
responsivity @ 870MHz	[V/W]	1489	1459	1370	
Flatness	[dB]	0.70	0.78	0.95	
Slope	[dB]	1.44	0.94	0.60	
S22 40 - 80MHz	[dB]	-21.2	-20.9	-20.8	
S22 80 - 160MHz	[dB]	-22.8	-22.2	-21.9	
S22 160 - 320MHz	[dB]	-24.3	-23.8	-23.5	
S22 320 - 640MHz	[dB]	-22.9	-20.8	-19.7	
S22 640 - 870MHz	[dB]	-17.6	-16.8	-15.7	
Vp_1	[V/mW]	0.82	0.84	0.85	
Current	[mA]	195	203	208	
d2 @ 54MHz	[dB]	-86.5	-82.6	-79.2	-71
d2 @ 746.5MHz	[dB]	-70.1	-67.5	-65.9	-61
d2 @ 854.5MHz	[dB]	-67.4	-64.4	-62.3	-58
d3 @ 445.25MHz	[dB]	-82.1	-78.5	-75.8	-68
d3 @ 745.25MHz	[dB]	-78.0	-73.6	-70.6	-67
d3 @ 853.25MHz	[dB]	-74.9	-70.8	-67.1	-63
EIN @ 40MHz	[pA/SQRT(Hz)]	9.6	10.1	10.6	11
EIN @ 750MHz	[pA/SQRT(Hz)]	9.7	10.2	10.7	11.5
EIN @ 870MHz	[pA/SQRT(Hz)]	10.6	11.3	11.9	12

CGO869 with Vpin6 = 24V measured at -20, 30 and 85°C

Delta's versus temperature

		average values				worst case values	
		-20 - 30	85 - 30	85 - 30 [dB]		-20 - 30	85 - 30
responsivity @ 40MHz	[V/W]	-31	-90	-0.76		-70	-353
responsivity @ 50MHz	[V/W]	-30	-88	-0.74		-70	-353
responsivity @ 870MHz	[V/W]	18	-143	-1.15		68	-442
Flatness	[dB]	0.07	0.18			0.28	0.28
Slope	[dB]	0.48	-0.37			0.59	-0.44
S22 40 - 80MHz	[dB]	-0.1	0.3			-0.4	0.5
S22 80 - 160MHz	[dB]	-0.4	0.5			-0.6	0.6
S22 160 - 320MHz	[dB]	-0.2	0.3			0.7	0.6
S22 320 - 640MHz	[dB]	-1.7	1.4			-2.2	1.8
S22 640 - 870MHz	[dB]	-0.7	1.1			-1.2	1.6
Vp_1	[V/mW]	-0.02	-0.05			-0.06	-0.27
Current	[mA]	-8	5			-9	5
d2 @ 54MHz	[dB]	-3.0	3.5			-0.8	4.8
d2 @ 746.5MHz	[dB]	-2.9	1.3			-2.2	2.9
d2 @ 854.5MHz	[dB]	-3.1	1.6			-2.2	3.5
d3 @ 445.25MHz	[dB]	-3.1	1.7			-1.8	3.9
d3 @ 745.25MHz	[dB]	-4.5	2.0			-3.3	4.6
d3 @ 853.25MHz	[dB]	-4.1	2.3			-2.4	4.8
EIN @ 40MHz	[pA/SQRT(Hz)]	-0.7	0.6			-1.4	1.4
EIN @ 750MHz	[pA/SQRT(Hz)]	-0.8	0.6			-1.0	0.9
EIN @ 870MHz	[pA/SQRT(Hz)]	-1.4	0.4			-2.4	1.4

Averages versus temperature

		-20°C	30°C	85°C	spec
responsivity @ 40MHz	[V/W]	1025	1072	982	
responsivity @ 50MHz	[V/W]	1037	1083	995	
responsivity @ 870MHz	[V/W]	1133	1154	1011	
Flatness	[dB]	0.97	0.90	1.08	
Slope	[dB]	0.88	0.55	0.18	
S22 40 - 80MHz	[dB]	-20.6	-20.5	-20.2	
S22 80 - 160MHz	[dB]	-22.1	-21.7	-21.3	
S22 160 - 320MHz	[dB]	-23.7	-23.6	-23.2	
S22 320 - 640MHz	[dB]	-23.5	-21.7	-20.3	
S22 640 - 870MHz	[dB]	-17.2	-16.9	-15.8	
Vp_1	[V/mW]	0.82	0.85	0.80	
Current	[mA]	195	203	208	
d2 @ 54MHz	[dB]	-87.7	-84.9	-81.4	-71
d2 @ 746.5MHz	[dB]	-71.0	-68.1	-66.8	-61
d2 @ 854.5MHz	[dB]	-67.9	-65.1	-63.5	-61
d3 @ 445.25MHz	[dB]	-85.2	-81.9	-80.2	-71
d3 @ 745.25MHz	[dB]	-82.0	-77.3	-75.2	-71
d3 @ 853.25MHz	[dB]	-78.1	-73.8	-71.5	-69
EIN @ 40MHz	[pA/SQRT(Hz)]	12.1	12.8	13.4	15
EIN @ 750MHz	[pA/SQRT(Hz)]	13.1	13.8	14.4	16
EIN @ 870MHz	[pA/SQRT(Hz)]	14.2	15.2	15.5	17