

**HiRel C-Band GaAs Power- MESFET**

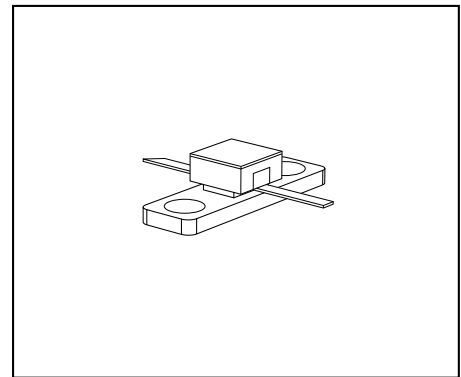
• **HiRel Discrete and Microwave Semiconductor**

- For professional power amplifiers
- For frequencies from 100 MHz to 8 GHz
- Hermetically sealed microwave power package
- Low thermal resistance for high voltage application
- Power adds efficiency > 55%

• **esa Space Qualification Expected 1998**

ESA/SCC Detail Spec. No.: 5614/006

Type Variante No.s 04 to 06



**ESD (Electrostatic discharge) sensitive device, observe handling precaution!**

Type	Marking	Pin Configuration				Package
		1=G	2=S	3=D	-	
CLY29-00	-	1=G	2=S	3=D	-	MWP-25
CLY29-05	-	1=G	2=S	3=D	-	MWP-25
CLY29-10	-	1=G	2=S	3=D	-	MWP-25

(q) Testing level: P: Professional testing  
 H: High Rel quality  
 S: Space quality  
 ES: ESA qualified

CLY29-nn: specifies output power level (see electrical characteristics)

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Drain-source voltage	$V_{DS}$	14	V
Drain-gate voltage	$V_{DG}$	16	
Gate-source voltage	$V_{GS}$	-6	
Drain current	$I_D$	700	mA
Gate forward current	$I_G$	4	
Compression level <sup>1)</sup> Operation Range 1  Operation Range 2 Operation Range3	$P_c$	1.5 at $V_{DS} \leq 9V$ 2.5 at $V_{DS} \leq 8V$ 3.5 at $V_{DS} \leq 7V$ 3.5 at $V_{DS} \leq 7V$ tbd	dB
Junction temperature	$T_j$	175	
Storage temperature	$T_{stg}$	-65...175	°C
Total power dissipation <sup>2)</sup>	$P_{tot}$	3.55	W
Soldering temperature <sup>3)</sup>	$T_{sol}$	230	°C

**Thermal Resistance**

Parameter	Symbol	Value	Unit
Junction - soldering point	$R_{thJS}$	$\leq 38$	K/W

<sup>1)</sup>Operating Range 1:  $135mA \leq I_D \leq 270mA$

Operating Range 2:  $I_D > 270mA$

Operating Range 3:  $I_D < 135mA$

<sup>2)</sup>At  $T_S = 40^\circ C$ . For  $T_S > 40^\circ C$  derating is required.

<sup>3)</sup>During 15 sec. maximum. The same terminal shall not be resoldered until 3 minutes have elapsed

**Electrical Characteristics** (at  $T_A = 25\text{ °C}$ ; unless otherwise specified)

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>DC Characteristics</b>					
Drain- source saturation current $V_{DS} = 2\text{ V}, V_{GS} = 0\text{ V}$	$I_{DSS}$	300	500	700	mA
Gate threshold voltage $V_{DS} = 3\text{ V}, I_D = 20\text{ mA}$	$-V_{Gth}$	1.6	2.6	3.6	V
Drain current at pinch-off, low $V_{DS}$ $V_{DS} = 3\text{ V}, V_{GS} = -3.8\text{ V}$	$I_{Dp3}$	-	-	50	$\mu\text{A}$
Gate current at pinch-off, low $V_{DS}$ $V_{DS} = 3\text{ V}, V_{GS} = -3.8\text{ V}$	$-I_{Gp3}$	-	-	20	
Drain current at pinch-off, high $V_{DS}$ $V_{DS} = 12\text{ V}, V_{GS} = -4\text{ V}$	$I_{Dp12}$	-	-	1000	
Gate current at pinch-off, high $V_{DS}$ $V_{DS} = 12\text{ V}, V_{GS} = -4\text{ V}$	$-I_{Gp12}$	-	-	400	
Transconductance $V_{DS} = 3\text{ V}, I_D = 200\text{ mA}$	$g_m$	150	190	-	mS
Thermal resistance junction to soldering point $V_{DS} = 9\text{ V}, I_D = 200\text{ mA}, T_S = 25\text{ °C}$	$R_{thJS}$	-	32	-	K/W

**Electrical Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>AC Characteristics</b>					
Linear power gain <sup>1)</sup> $V_{DS} = 9\text{ V}$ , $I_D = 200\text{ mA}$ , $f = 2.3\text{ GHz}$ , $P_{IN} = 0\text{ dBm}$ CLY29-00 CLA29-05 CLY29-10	$G_{Ip}$	13.5 14 14	15 15.2 15.2	- - -	dB
Output power at 1 dB gain compression <sup>1)</sup> $V_{DS} = 9\text{ V}$ , $I_{D(RF\ off)} = 200\text{ mA}$ , $f = 2.3\text{ GHz}$ CLY29-00 CLY29-05 CLY29-10	$P_{1dB}$	- - -	28.8 29.3 30	- - -	dBm
Output power <sup>1)</sup> $V_{DS} = 9\text{ V}$ , $I_{D(RF\ off)} = 200\text{ mA}$ , $f = 2.3\text{ GHz}$ , $P_{IN} = 16.5\text{ dBm}$ CLY29-00 CLY29-05 CLY29-10	$P_{out}$	28.5 29 29.5	28.8 29.3 30	- - -	
Power added efficiency <sup>1)2)</sup> $V_{DS} = 9\text{ V}$ , $I_{D(RF\ off)} = 200\text{ mA}$ , $f = 2.3\text{ GHz}$ , $P_{IN} = 16.5\text{ dBm}$ CLY29-00 CLY29-05 CLY29-10	$PAE$	40 45 45	50 52 55	- - -	%

<sup>1</sup>RF Power characteristics given for power matching conditions

<sup>2</sup>Power added efficiency:  $PAE = (P_{RFout} - P_{RFin})/P_{DC}$

**Typical Common Source S-Parameters**
 $V_{DS} = 3V, I_D = 180 \text{ mA}, Z_0 = 50 \Omega$ 

<i>f</i>	<i>S</i> <sub>11</sub>		<i>S</i> <sub>21</sub>		<i>S</i> <sub>12</sub>		<i>S</i> <sub>22</sub>		k-Fact.	<i>S</i> <sub>21</sub> / <i>S</i> <sub>12</sub>	MAG
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG			
0.5	0.87	-78	7.618	129	0.0396	50	0.227	-138	0.37	22.8	-
0.6	0.847	-83	7.318	126	0.0412	47	0.237	-141	0.43	22.5	-
0.7	0.824	-88	6.983	123	0.0429	44	0.249	-144	0.49	22.1	-
0.8	0.805	-95	6.62	119	0.0447	41	0.262	-148	0.55	21.7	-
0.9	0.791	-103	6.248	114	0.0468	37	0.277	-152	0.58	21.3	-
1	0.787	-111	5.881	109	0.0493	34	0.293	-155	0.59	20.8	-
1.1	0.783	-118	5.537	104	0.0512	31	0.307	-159	0.61	20.3	-
1.2	0.778	-125	5.213	99	0.0529	28	0.319	-162	0.63	19.9	-
1.3	0.774	-131	4.916	95	0.0541	26	0.33	-165	0.66	19.6	-
1.4	0.771	-137	4.641	91	0.0552	24	0.34	-167	0.69	19.2	-
1.5	0.768	-142	4.387	87	0.0562	22	0.348	-170	0.72	18.9	-
1.6	0.766	-147	4.155	83	0.057	20	0.356	-172	0.75	18.6	-
1.7	0.764	-152	3.942	80	0.0578	18	0.363	-174	0.78	18.3	-
1.8	0.763	-156	3.746	77	0.0584	17	0.37	-176	0.82	18.1	-
1.9	0.761	-160	3.565	73	0.0587	15	0.376	-178	0.85	17.8	-
2	0.76	-163	3.401	70	0.0593	14	0.382	-180	0.88	17.6	-
2.1	0.759	-167	3.248	68	0.0597	12	0.388	179	0.91	17.4	-
2.2	0.759	-170	3.106	65	0.0602	11	0.393	177	0.95	17.1	-
2.3	0.758	-173	2.977	62	0.0606	10	0.398	176	0.98	16.9	-
2.4	0.758	-176	2.858	59	0.0607	9	0.403	174	1.01	16.7	16.1
2.5	0.757	-179	2.747	57	0.061	8	0.408	173	1.04	16.5	15.3
2.6	0.757	179	2.644	54	0.0615	7	0.412	172	1.07	16.3	14.7
2.7	0.757	176	2.548	52	0.0619	6	0.417	170	1.1	16.1	14.2
2.8	0.757	173	2.459	49	0.0624	6	0.421	169	1.13	16	13.8
2.9	0.756	171	2.374	47	0.063	5	0.424	168	1.15	15.8	13.4
3	0.756	169	2.295	44	0.0634	4	0.427	167	1.18	15.6	13
3.1	0.756	166	2.223	42	0.0638	4	0.431	165	1.21	15.4	12.7
3.2	0.756	164	2.155	40	0.0643	3	0.435	164	1.23	15.3	12.3
3.3	0.756	162	2.091	37	0.065	2	0.439	163	1.25	15.1	12
3.4	0.756	160	2.03	35	0.0655	2	0.442	162	1.28	14.9	11.8
3.5	0.756	158	1.973	33	0.0659	1	0.447	161	1.3	14.8	11.5

**Typical Common Source S-Parameters**
 $V_{DS} = 3V, I_D = 180 \text{ mA}, Z_0 = 50 \Omega$ 

<i>f</i>	<i>S</i> <sub>11</sub>		<i>S</i> <sub>21</sub>		<i>S</i> <sub>12</sub>		<i>S</i> <sub>22</sub>		k-Fact.	<i>S</i> <sub>21</sub> / <i>S</i> <sub>12</sub>	MAG
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	MAG	dB	dB
3.6	0.756	156	1.919	31	0.0666	1	0.451	160	1.32	14.6	11.2
3.7	0.756	154	1.866	28	0.067	0	0.456	158	1.34	14.4	11
3.8	0.756	152	1.817	26	0.0673	-1	0.46	157	1.36	14.3	10.7
3.9	0.756	150	1.77	24	0.068	-1	0.465	156	1.38	14.2	10.5
4	0.756	148	1.725	22	0.0685	-2	0.47	155	1.39	14	10.3
4.1	0.757	146	1.681	20	0.0689	-2	0.475	153	1.42	13.9	10
4.2	0.757	144	1.639	18	0.0691	-3	0.479	152	1.44	13.8	9.8
4.3	0.758	142	1.599	15	0.0696	-4	0.483	151	1.46	13.6	9.6
4.4	0.758	140	1.56	13	0.0702	-4	0.487	150	1.47	13.5	9.4
4.5	0.759	138	1.524	11	0.0703	-5	0.491	148	1.49	13.4	9.2
4.6	0.759	136	1.488	9	0.0711	-6	0.495	147	1.5	13.2	9
4.7	0.76	134	1.457	7	0.0717	-6	0.499	146	1.51	13.1	8.9
4.8	0.762	133	1.431	6	0.0722	-7	0.503	145	1.51	13	8.8
4.9	0.763	132	1.409	4	0.0727	-7	0.506	145	1.51	12.9	8.7
5	0.764	131	1.392	3	0.0733	-7	0.509	144	1.5	12.8	8.6

**Typical Common Source S-Parameters**
 $V_{DS} = 5V, I_D = 180\text{ mA}, Z_0 = 50\ \Omega$ 

f	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		k-Fact.	S <sub>21</sub> /S <sub>12</sub>	MAG
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG			
0.5	0.873	-76	8.549	129	0.0311	50	0.182	-88	0.41	24.4	-
0.6	0.85	-81	8.222	127	0.0326	48	0.183	-93	0.48	24	-
0.7	0.827	-86	7.852	123	0.0342	45	0.186	-98	0.55	23.6	-
0.8	0.807	-93	7.457	119	0.0359	42	0.19	-105	0.61	23.2	-
0.9	0.793	-100	7.051	114	0.0378	39	0.196	-111	0.65	22.7	-
1	0.787	-108	6.651	109	0.0398	36	0.205	-117	0.66	22.2	-
1.1	0.783	-116	6.269	104	0.0413	33	0.213	-123	0.68	21.8	-
1.2	0.778	-123	5.91	99	0.0426	31	0.221	-128	0.71	21.4	-
1.3	0.774	-129	5.577	94	0.0437	28	0.228	-133	0.74	21.1	-
1.4	0.771	-135	5.27	90	0.0446	26	0.236	-137	0.77	20.7	-
1.5	0.768	-140	4.986	86	0.0454	24	0.243	-140	0.81	20.4	-
1.6	0.765	-145	4.725	82	0.046	23	0.25	-143	0.84	20.1	-
1.7	0.764	-150	4.485	79	0.0465	21	0.257	-146	0.88	19.8	-
1.8	0.762	-154	4.261	75	0.0471	19	0.264	-149	0.91	19.6	-
1.9	0.761	-158	4.057	72	0.0475	18	0.272	-151	0.95	19.3	-
2	0.76	-161	3.869	69	0.0479	16	0.279	-154	0.98	19.1	-
2.1	0.759	-165	3.694	66	0.0483	16	0.286	-156	1.02	18.8	18
2.2	0.758	-168	3.533	63	0.0484	14	0.292	-158	1.06	18.6	17.1
2.3	0.757	-171	3.384	60	0.0488	14	0.299	-160	1.1	18.4	16.5
2.4	0.757	-174	3.247	57	0.049	13	0.306	-161	1.13	18.2	16
2.5	0.757	-177	3.119	54	0.0492	12	0.313	-163	1.17	18	15.5
2.6	0.757	-180	3	52	0.0495	11	0.319	-165	1.2	17.8	15.1
2.7	0.756	178	2.889	49	0.0495	11	0.326	-166	1.25	17.7	14.7
2.8	0.756	175	2.786	47	0.05	10	0.332	-168	1.27	17.5	14.3
2.9	0.756	173	2.689	44	0.0505	9	0.338	-169	1.3	17.3	14
3	0.756	170	2.598	41	0.0509	9	0.344	-171	1.33	17.1	13.7
3.1	0.757	168	2.514	39	0.0514	8	0.351	-172	1.35	16.9	13.4
3.2	0.757	166	2.434	37	0.0516	8	0.357	-173	1.38	16.7	13.1
3.3	0.757	164	2.36	34	0.052	8	0.364	-175	1.4	16.6	12.8
3.4	0.757	162	2.289	32	0.0525	8	0.37	-176	1.43	16.4	12.5
3.5	0.757	159	2.222	29	0.053	8	0.377	-178	1.45	16.2	12.3

**Typical Common Source S-Parameters**
 $V_{DS} = 5V, I_D = 180 \text{ mA}, Z_0 = 50 \Omega$ 

<i>f</i>	<i>S</i> <sub>11</sub>		<i>S</i> <sub>21</sub>		<i>S</i> <sub>12</sub>		<i>S</i> <sub>22</sub>		k-Fact.	<i>S</i> <sub>21</sub> / <i>S</i> <sub>12</sub>	MAG
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	MAG	dB	dB
3.6	0.758	157	2.158	27	0.0536	7	0.384	-179	1.46	16	12
3.7	0.758	155	2.097	25	0.0541	7	0.391	180	1.48	15.9	11.8
3.8	0.758	153	2.039	22	0.0546	7	0.399	178	1.5	15.7	11.5
3.9	0.759	151	1.985	20	0.055	6	0.406	177	1.52	15.6	11.3
4	0.759	149	1.932	18	0.0557	6	0.413	175	1.53	15.4	11.1
4.1	0.76	147	1.882	15	0.0563	6	0.42	174	1.54	15.2	10.9
4.2	0.76	145	1.833	13	0.0568	6	0.426	172	1.56	15.1	10.7
4.3	0.761	143	1.786	11	0.0575	5	0.432	171	1.56	14.9	10.5
4.4	0.762	141	1.741	9	0.058	4	0.438	169	1.58	14.8	10.3
4.5	0.762	139	1.698	7	0.0587	4	0.445	168	1.58	14.6	10.1
4.6	0.763	137	1.657	4	0.0591	3	0.452	166	1.59	14.5	9.9
4.7	0.764	136	1.621	2	0.0596	3	0.458	165	1.6	14.3	9.8
4.8	0.765	134	1.59	1	0.0601	3	0.464	164	1.6	14.2	9.7
4.9	0.766	133	1.564	-1	0.0604	2	0.47	163	1.6	14.1	9.6
5	0.768	132	1.544	-2	0.0606	2	0.474	162	1.6	14.1	9.5



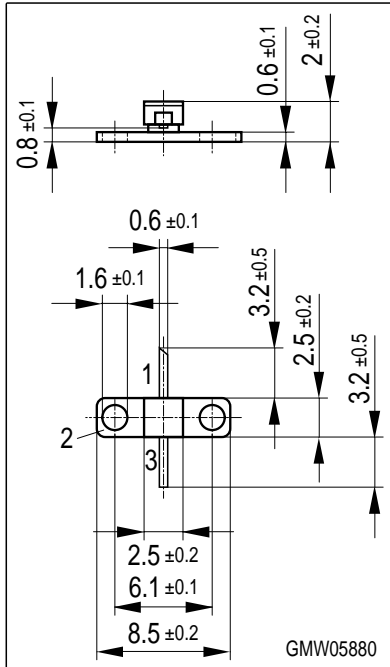
**Typical Common Source S-Parameters**
 $V_{DS} = 9V, I_D = 180 \text{ mA}, Z_0 = 50 \Omega$ 

f	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		k-Fact.	S <sub>21</sub> /S <sub>12</sub>	MAG
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG	MAG	dB	dB
0.5	0.874	-76	8.885	129	0.0245	51	0.272	-48	0.48	25.6	-
0.6	0.852	-80	8.544	126	0.0257	48	0.266	-52	0.56	25.2	-
0.7	0.829	-86	8.159	122	0.0269	46	0.261	-56	0.64	24.8	-
0.8	0.81	-93	7.748	118	0.0283	43	0.256	-60	0.7	24.4	-
0.9	0.796	-100	7.326	113	0.0296	40	0.252	-65	0.75	23.9	-
1	0.791	-108	6.913	108	0.0312	37	0.249	-71	0.76	23.5	-
1.1	0.786	-115	6.519	103	0.0324	34	0.248	-77	0.79	23	-
1.2	0.782	-122	6.147	98	0.0335	32	0.247	-82	0.82	22.6	-
1.3	0.778	-128	5.801	93	0.0342	30	0.248	-86	0.86	22.3	-
1.4	0.775	-134	5.482	89	0.035	28	0.249	-91	0.89	21.9	-
1.5	0.772	-140	5.187	84	0.0355	27	0.252	-95	0.93	21.6	-
1.6	0.77	-144	4.916	81	0.036	25	0.256	-99	0.97	21.4	-
1.7	0.768	-149	4.665	77	0.0363	24	0.26	-103	1.01	21.1	20.4
1.8	0.767	-153	4.433	73	0.0367	22	0.265	-107	1.06	20.8	19.4
1.9	0.766	-157	4.22	70	0.037	21	0.27	-110	1.1	20.6	18.7
2	0.765	-161	4.024	66	0.0371	21	0.277	-114	1.15	20.4	18
2.1	0.765	-165	3.84	63	0.0373	20	0.283	-117	1.19	20.1	17.5
2.2	0.764	-168	3.672	60	0.0375	19	0.29	-120	1.23	19.9	17
2.3	0.764	-171	3.516	57	0.0377	18	0.297	-123	1.27	19.7	16.5
2.4	0.764	-174	3.372	54	0.0379	17	0.305	-126	1.31	19.5	16.1
2.5	0.764	-177	3.238	51	0.0382	17	0.313	-128	1.35	19.3	15.8
2.6	0.764	-179	3.112	48	0.0385	16	0.32	-131	1.38	19.1	15.4
2.7	0.764	178	2.995	45	0.0386	16	0.328	-133	1.42	18.9	15
2.8	0.764	176	2.885	43	0.0388	17	0.337	-136	1.46	18.7	14.7
2.9	0.764	173	2.782	40	0.0393	17	0.344	-138	1.49	18.5	14.4
3	0.764	171	2.686	37	0.0396	17	0.352	-140	1.52	18.3	14.1
3.1	0.765	169	2.596	35	0.04	17	0.36	-142	1.54	18.1	13.8
3.2	0.765	166	2.512	32	0.0406	17	0.368	-145	1.56	17.9	13.5
3.3	0.765	164	2.432	30	0.0411	17	0.377	-147	1.58	17.7	13.3
3.4	0.766	162	2.357	27	0.0416	17	0.386	-149	1.59	17.5	13
3.5	0.766	160	2.286	25	0.0422	17	0.394	-151	1.6	17.3	12.8

**Typical Common Source S-Parameters**
 $V_{DS} = 9V, I_D = 180 \text{ mA}, Z_0 = 50 \Omega$ 

<i>f</i>	<i>S</i> <sub>11</sub>		<i>S</i> <sub>21</sub>		<i>S</i> <sub>12</sub>		<i>S</i> <sub>22</sub>		k-Fact.	<i>S</i> <sub>21</sub> / <i>S</i> <sub>12</sub>	MAG
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG			
3.6	0.766	158	2.218	22	0.0429	17	0.403	-153	1.61	17.1	12.5
3.7	0.767	156	2.152	20	0.0436	17	0.411	-155	1.62	16.9	12.3
3.8	0.768	154	2.091	17	0.0444	17	0.42	-157	1.61	16.7	12.1
3.9	0.769	152	2.034	15	0.0451	17	0.428	-159	1.61	16.5	11.9
4	0.769	150	1.977	12	0.0458	17	0.436	-162	1.62	16.4	11.7
4.1	0.77	148	1.924	10	0.0466	17	0.445	-164	1.62	16.2	11.6
4.2	0.771	146	1.872	8	0.0472	17	0.452	-166	1.62	16	11.4
4.3	0.772	144	1.822	5	0.0481	17	0.46	-168	1.62	15.8	11.2
4.4	0.772	142	1.773	3	0.0491	17	0.468	-170	1.61	15.6	11
4.5	0.773	140	1.727	1	0.05	16	0.476	-172	1.6	15.4	10.8
4.6	0.775	138	1.683	-2	0.051	16	0.485	-174	1.59	15.2	10.7
4.7	0.776	136	1.644	-4	0.0517	16	0.493	-176	1.58	15	10.6
4.8	0.778	135	1.611	-6	0.0527	16	0.5	-177	1.55	14.9	10.5
4.9	0.779	134	1.584	-7	0.0533	16	0.507	-178	1.54	14.7	10.4
5	0.781	133	1.562	-9	0.0539	16	0.512	-179	1.52	14.6	10.4

MWP-25 Package



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