Performance Comparison between the P1000 and a popular Competitors' Line Drivers

How does the P1000 stack up against its competition? To find out, we used our LabVIEW test setup to test primarily distortion related specifications vs. load resistances of the P1000, the Competitor part (COMP) (already reported), and, newly added, Competitor part 2 (COMP2). The Competitors' evaluation board was adjusted to be as close to the conditions and signal levels of the P1000's as we could. The gains are not the same, so the input voltages were adjusted to match the output values. The tests were done at VDD=10V, Vout=6Vpp which gives only 2V overhead ground to signal and VDD to signal. For COMP2, the conditions of 4Vppdiff and VDD=12V at 2 Ohms, so we were a little easier on this one. Also, the test was also done at 15V to remove any effects due to low overhead voltages.

Below are the Overall Conditions for testing, except where noted.

VDD = 10V (12V Comp2 specs) and 15V
Vout=3Vp or 6Vpp (2.2Vp or 4.4Vpp for Comp2) for both MPTR and Harmonic distortion
MTPR signal comprises of 260 tones (appx 9k to 480kHz), Fund freq.= 488.28125Hz, CF=4
V3P3 = 3.3V (interface signal voltage)
Ambient Temperature= 27C
Load= 1 Ohm, 2 Ohm, 10 Ohm, and 100 Ohms (AC coupled resistive load)

The comparison between the devices uses only one part, but the P1000 part is an average representation of the results we measured on a reasonable sample of P1000 parts. The COMP/COMP2 parts that came on the board are assumed typical. After testing the parts, the below spec comparison charts were created as well as the gallery of test results from the LabVIEW test setup. Regarding the measurement system, the source of the test setup is a NI PXI-5441 with 16Bit/100MHz clock DAC and the sampler is a NI PXI-5122 with 14Bit/100Ms/s A/D.

The results reveal significant differences in performance. At the Load=100 Ohms, the P1000 looks better at harmonic distortion, but the Multi Tone Power Ratio (MTPR) looks about the same as COMP, but better than COMP2. However, when measuring with a 10 Ohm load, the COMP and COMP2 parts perform much worst for both MTPR and harmonic distortion. At 2 Ohms, both competitor parts are significantly worse than the P1000, especially COMP2 since the signal level was backed off to 2Vpdiff. At 1 Ohm with 3A peaks, the P1000's MTPR performance is much better than the COMP and COMP2 at 10 Ohms. COMP and COMP2 are not rated at 3A, they were not measured with a 1 Ohm load. Clearly, the P1000 drives lower impedance loads with lower distortions and higher MTPR when transmitting demanding OFDM signals.

All parts performed about the same for VDD=10V (12V for COMP2) and VDD=15V, so only the scope graphs from the 15V (12V) tests were included.

In summary, the P1000 can drive the hard loads of 1-10 Ohms at very clean signal levels, where the COMP and COMP2 are not capable of driving such loads with the same fidelity. ***The P1000 transmits OFDM signals with high MTPR even when connect to low impedance loads.*** Power lines present a hostile environment to the PLC systems, having a line driver to deliver clean OFDM signals at low impedances to start with, will provide the additional margin to achieve reliable, high data rate signals for your customer's applications.

Narrow Band PLC Line Driver IP P1000 vs. Competitors (added a Competitor)

Transmitter Supply Current, Bandwidth, Stability, Slew Rate

(Lowest Load is 1 Ohm for the P1000 and 2 Ohm for the Competitor COMP)

Description	Conditions	P1000	COMP	COMP2	Units	Comments
VDD Current	VDD=10V, no signal	**50**	64	40	mA	
VDD Current	VDD=15V, same	**50**	66	41	mA	
Gain	100 Ohm load, VDD=10V	17.99	16.87	15.5	dB	8V/V and 7V/V and 6V/V
Gain	10 Ohm load, VDD=10V	17.98	16.82	15.47	dB	
Gain	P1000=1 Ohm, COMP=2 Ohm, VDD=10V	**17.93**	16.56	15.38	dB	Changed the least
Gain	100 Ohm load, VDD=15V	17.99	16.87	15.5	dB	
Gain	10 Ohm load, VDD=15V	17.98	16.82	15.48	dB	
Gain	P1000=1 Ohm, COMP=2 Ohm, VDD=15V	**17.93**	16.56	15.37	dB	Changed the least
3dB Bandwidth	100 Ohm load, VDD=10V	3.0	**4.1**	8.85	MHz	
3dB Bandwidth	10 Ohm load, VDD=10V	**3.1**	2.24	8.7	MHz	
3dB Bandwidth	P1000=1 Ohm, COMP=2 Ohm, VDD=10V	**2.8**	0.88	6.75	MHz	COMP Bandwidth significantly reduces with load
3dB Bandwidth	100 Ohm load, VDD=15V	3.0	**3.8**	8.85	MHz	
3dB Bandwidth	10 Ohm load, VDD=15V	**3.0**	2.24	8.7	MHz	
3dB Bandwidth	P1000=1 Ohm, COMP=2 Ohm, VDD=15V	**2.8**	0.88	6.75	MHz	Same comment
Small Signal Pulse Overshoot	100 Ohm load, VTXO=100mVp, VDD=10V	1.6	1.5	>25	%	
Small Signal Pulse Overshoot	10 Ohm load, same	1.4	1.8	>25	%	
Small Signal Pulse Overshoot	P1000=1 Ohm, COMP=2 Ohm, same	1.5	1.0	>25	%	
Small Signal Pulse Overshoot	100 Ohm load, VTXO=100mVp, VDD=15V	1.6	1.5	>25	%	
Small Signal Pulse Overshoot	10 Ohm load, same	1.4	1.8	>25	%	
Small Signal Pulse Overshoot	P1000=1 Ohm, COMP=2 Ohm, same	1.5	1.1	>25	%	
Slew Rate Plus	100 Ohm load, 12Vpp, VDD=20V	**118**	59	120	V/us	P1000 SR is double
Slew Rate Negative	same	**-118**	-59	-120	V/us	
Full Power Bandwidth	Calculated, 100 Ohm load, 6Vp, VDD=20V	**3.1**	1.6	3.2	MHz	

Narrow Band PLC Line Driver IP P1000 vs. Competitors (added a Competitor)

Transmitter Distortion

(Lowest Load is 1 Ohm for the P1000 and 2 Ohm for the Competitors COMP and COMP2)

Description	Conditions	P1000	COMP	COMP2	Units	
2nd Harmonic	100 Ohm load, Vout=3Vp, Fund Freq=500kHz, VDD=10V	**-89**	-62	-68	dB	COMP2 probably would have lower 2nd harmonics if I measured it differentially
2nd Harmonic	10 Ohm load, same	**-71**	-42	-53	dB	
2nd Harmonic	P1000=1 Ohm, COMP=2 Ohm, same	**-54**	-12	-28	dB	
2nd Harmonic	100 Ohm load, Vout=3Vp, Fund Freq=500kHz. VDD=15V	**-95**	-61	-71	dB	
2nd Harmonic	10 Ohm load, same	**-72**	-41	-51	dB	
2nd Harmonic	P1000=2 Ohm, COMP=2 Ohm, same	**-58**	-10	-29	dB	
2nd Harmonic	P1000=1 Ohm, same	**-54**			dB	3Ap, P1000 better than COMP's 10 Ohms
3rd Harmonic	100 Ohm load, VDD=10V	**-85**	-68	-82	dB	
3rd Harmonic	10 Ohm load, same	**-69**	-33	-60	dB	
3rd Harmonic	P1000=1 Ohm, COMP=2 Ohm, same	**-60**	-31	-26	dB	
3rd Harmonic	100 Ohm load, VDD=15V	**-88**	-71	-81	dB	
3rd Harmonic	10 Ohm load, same	**-69**	-33	-59	dB	
3rd Harmonic	P1000=2 Ohm, COMP=2 Ohm, same	**-63**	-29	-15	dB	
3rd Harmonic	P1000=1 Ohm, same	**-60**			dB	P1000 (3Ap) better than COMP's 10 Ohm's
MTPR Average Bin	100 Ohm load, 3Vp, CF=4, 260 tones (appx 9k to 480kHz) Fund freq.= 488.28125Hz, VDD=10V	92	91	73	dB	
MTPR Average Bin	10 Ohm load, same	**91**	61	44	dB	
MTPR Average Bin	P1000=1 Ohm, COMP=2 Ohm, same	**71**	43	18	dB	P1000 (3Ap) better than both COMP and COMP2 10 Ohm's
MTPR Average Bin	100 Ohm load, same as above, VDD=15V	92	91	73	dB	
MTPR Average Bin	10 Ohm load, same	**91**	62	44	dB	
MTPR Average Bin	P1000=2 Ohm, COMP=2 Ohm, same	**76**	42	31	dB	
MTPR Average Bin	P1000=1 Ohm,	**72**			dB	P1000 (3Ap) better than both COMP and COMP2 10 Ohm's
MTPR Peak Bin	100 Ohm load, VDD=10V	77	75	58	dB	
MTPR Peak Bin	10 Ohm load, same	**77**	43	31	dB	
MTPR Peak Bin	P1000=1 Ohm, COMP=2 Ohm, same	**59**	31	18	dB	
MTPR Peak Bin	100 Ohm load, VDD=15V	77	76	59	dB	
MTPR Peak Bin	10 Ohm load, same	**75**	43	31	dB	
MTPR Peak Bin	P1000=2 Ohm, COMP=2 Ohm, same	**63**	30	18	dB	
MTPR Peak Bin	P1000=1 Ohm, same	**60**			dB	P1000 (3Ap) better than COMP's 10 Ohm's

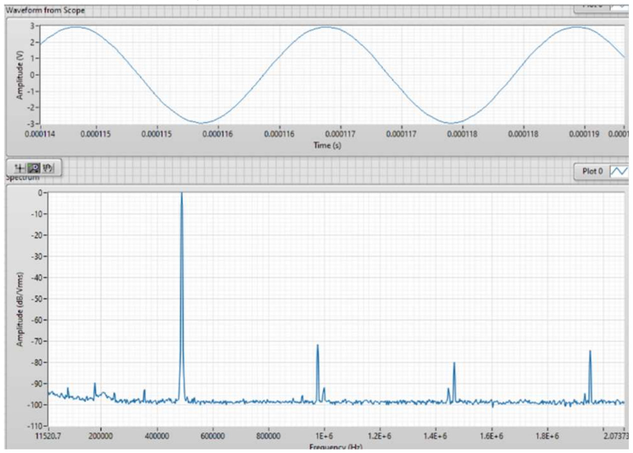
Narrow Band PLC Line Driver IP P1000 vs. Competitors (added a Competitor)

Harmonic Distortion Test Results

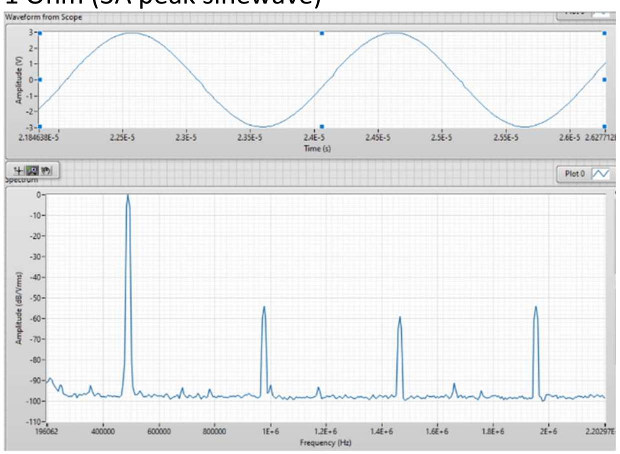
Shown are the time domain output signal and its FFT.

P1000 TX

Load = 10 Ohms, VDD=15V

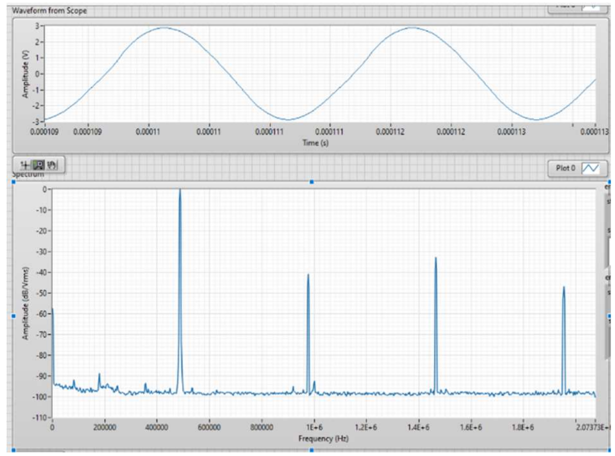


1 Ohm (3A peak sinewave)

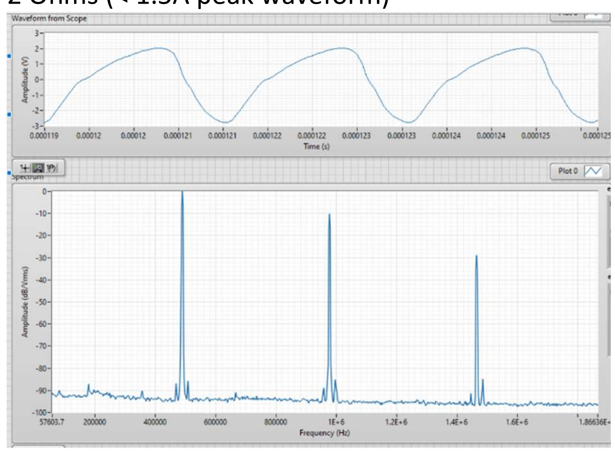


Competitor Line Driver (COMP)

Load = 10 Ohms VDD=15V

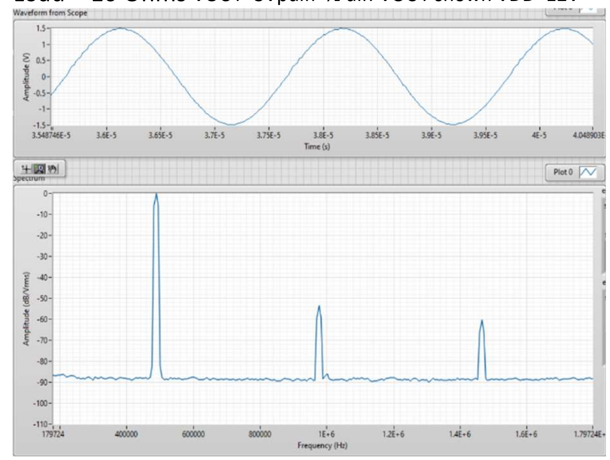


2 Ohms (< 1.5A peak waveform)

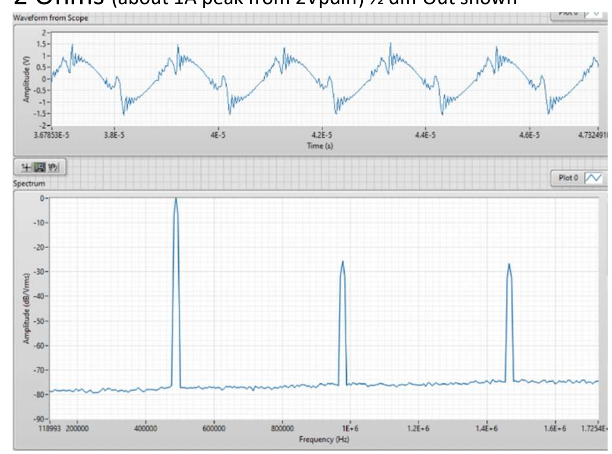


Competitor 2 Line Driver (COMP2)

Load = 10 Ohms VOUT=3Vpdiff ½ diff VOUT shown VDD=12V



2 Ohms (about 1A peak from 2Vpdiff) ½ diff Out shown



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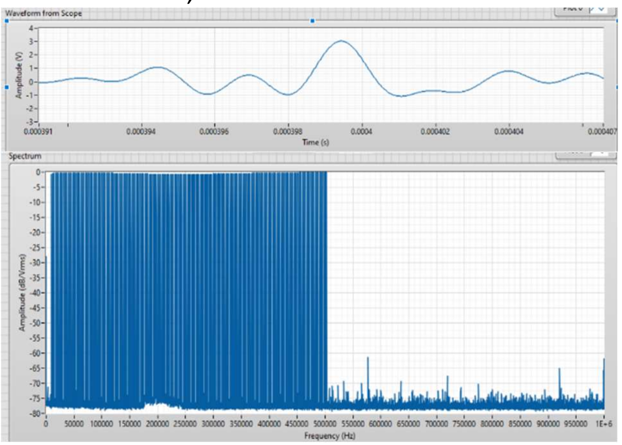
Narrow Band PLC Line Driver IP P1000 vs. Competitors (added a Competitor)

MTPR Signal Testing Results

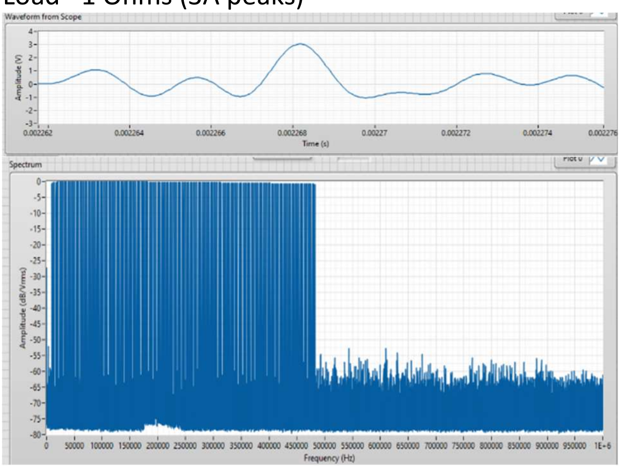
Graphs shown below are 1) excerpt of the OFDM signal at a 3V peak and 2) the normalized FFT of the output for each load for both parts.

P1000 TX

Load= 10 Ohms, VDD=15V

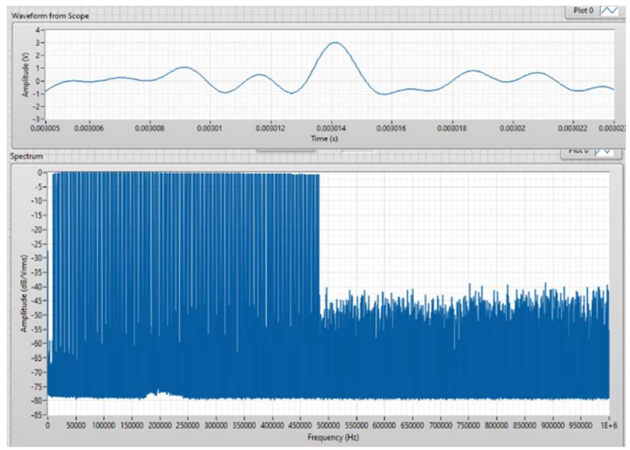


Load= 1 Ohms (3A peaks)

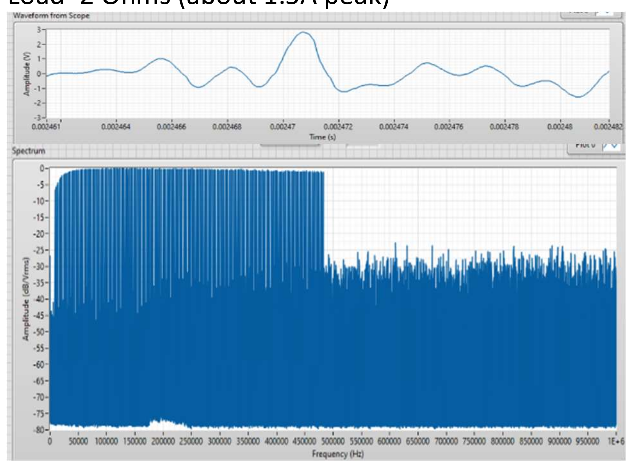


Competitor Line Driver (COMP)

Load = 10 Ohms VDD=15V

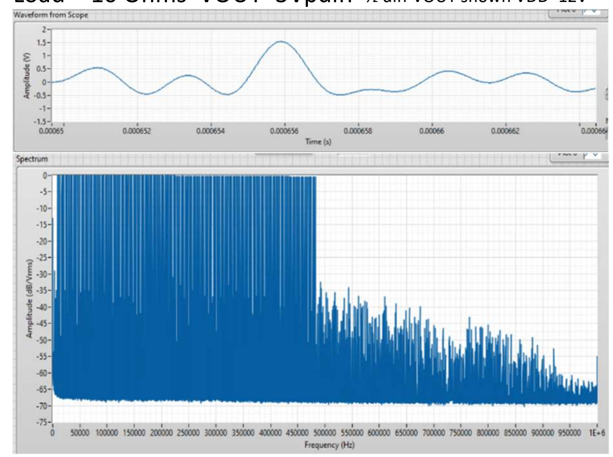


Load=2 Ohms (about 1.5A peak)



Competitor 2 Line Driver (COMP2)

Load = 10 Ohms VOUT=3Vpdiff ½ diff VOUT shown VDD=12V



Load=2 Ohms (about 1A peak from 2Vpdiff) ½ diff Out shown