

FORM 2

THE PATENTS ACT, 1970
(39 of 1970)
AND
THE PATENTS RULES, 2003

**COMPLETE
SPECIFICATION**

(See Section 10; rule 13)

TITLE OF THE INVENTION

“CONTROL SYSTEM FOR A POWER AMPLIFIER”

APPLICANT

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The following specification particularly describes
the invention and the manner in which
it is to be performed

Claims

1. Apparatus for controlling a gain and phase of an input signal input to a power amplifier (301), the apparatus comprising:
- 5 gain control means (302) for controlling the gain of the input signal;
phase control means (303) for controlling the phase of the input signal;
a gain control loop (310) configured to control the gain control means based on a power level of the input signal and a power level of an amplified signal output by the power amplifier, to obtain a predetermined gain of the amplified signal; and
- 10 a phase control loop (320) configured to obtain an error signal related to a phase difference between a first signal derived from the input signal and a second signal derived from the amplified signal, and control the phase control means based on the error signal to obtain a predetermined phase of the amplified signal,
- wherein the phase control loop is arranged to delay the first signal before
- 15 obtaining the error signal, such that the delayed first signal and the second signal used to obtain the error signal correspond to the same part of the input signal.
2. The apparatus of claim 1, wherein the gain control loop is configured to receive a third signal derived from the input signal and a fourth signal derived from
- 20 the amplified signal, and
- wherein the gain control loop is configured to compare a power level of the third signal and a power level of the fourth signal and control the gain control means based on the result of the comparison.
- 25 3. The apparatus of claim 2, further comprising:
- an input coupler (304) configured to receive the input signal and output the third signal, the input coupler having a first coupling factor; and
- an output coupler (305) configured to receive the amplified signal and output the fourth signal, the output coupler having a second coupling factor,
- 30 wherein the first and second coupling factors are selected such that when the amplified signal has the predetermined gain, the third signal and the fourth signal have substantially the same power level.

4. The apparatus of claim 2 or 3, wherein the gain control loop comprises:
a first detector (311) configured to measure a power level of the third signal;
and
a second detector (312) configured to measure a power level of the fourth
5 signal,
wherein the first and second detectors are matched root-mean-squared RMS
detectors.
5. The apparatus of claim 2 or 3, wherein the gain control loop comprises:
10 a first detector (311) configured to measure a power level of the third signal;
a second detector (312) configured to measure a power level of the fourth
signal; and
means (315) for scaling an output of the first detector or an output of the
second detector, so that the outputs of the first and second detectors are
15 substantially identical when the third and fourth signals have the same power.
6. The apparatus of claim 5, wherein the amplified signal is clipped by the
power amplifier, the apparatus further comprising:
a limiter configured to clip the input signal in correspondence with the
20 clipping of the amplified signal by the power amplifier, such that the third signal
received by the first detector and the fourth signal received by the second detector
are clipped by substantially the same amount.
7. The apparatus of any one of the preceding claims, wherein the phase control
25 loop comprises:
delaying means (321) for delaying the first signal;
error signal generating means (322) for generating the error signal based on
the second signal and the delayed first signal;
a detector (323) for measuring a power of the error signal; and
30 processing means (324) configured to control the phase control means based
on the measured power of the error signal,
wherein the delaying means is configured such that the electrical length of a
first path to the error signal generating means via the power amplifier is

substantially the same as the electrical length of a second path to the error signal generating means via the delaying means.

8. The apparatus of claim 7, wherein the processing means is configured to
5 control the phase control means in order to minimise the measured power of the error signal.

9. The apparatus of any one of the preceding claims, wherein a current gain and phase of the amplified signal is dependent on an operational history of the power
10 amplifier.

10. A satellite comprising:
a power amplifier; and
the apparatus of any one of the preceding claims, configured to control the
15 gain and phase of the input signal input to the power amplifier.

11. A method for controlling a gain and phase of an input signal input to a power amplifier (301), the method comprising:
controlling the gain of the input signal based on a power level of the input
20 signal and a power level of an amplified signal output by the power amplifier, to obtain a predetermined gain of the amplified signal;
delaying a first signal derived from the input signal;
obtaining an error signal related to a phase difference between the delayed first signal and a second signal derived from the amplified signal; and
25 controlling the phase of the input signal according to the error signal to obtain a predetermined phase of the amplified signal,
wherein the first signal is delayed such that the delayed first signal and the second signal used to obtain the error signal correspond to the same part of the input signal.

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12. The method of claim 11, further comprising:
comparing a power level of a third signal derived from the input signal and a power level of a fourth signal derived from the amplified signal,

wherein the gain of the input signal is controlled based on the result of the comparison.

13. The method of claim 12, wherein the third and fourth signals are arranged to
5 have the same power level when the amplified signal has the predetermined gain.

14. A satellite comprising:
a power amplifier (701) for receiving an input signal and outputting an amplified signal;
10 gain control means (702) for controlling a gain of the input signal;
phase control means (703) for controlling a phase of the input signal; and
a control loop (720) configured to obtain an error signal related to a phase difference between a first signal derived from the input signal and a second signal derived from the amplified signal, and control the gain control means and phase
15 control means based on the error signal to obtain a predetermined gain and phase of the amplified signal,

wherein the control loop is arranged to delay the first signal before obtaining the error signal, such that the delayed first signal and the second signal used to obtain the error signal correspond to the same part of the input signal.

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15. The satellite of claim 14, wherein the control loop comprises:
a first coupler (705) for outputting the first signal;
a second coupler (707) for outputting the second signal;
delaying means (721) for delaying the first signal;
25 error signal generating means (722) for receiving the delayed first signal and the second signal, and generating the error signal related to the phase difference between the delayed first signal and the second signal;
a detector (723) for measuring a power of the error signal; and
processing means (724) configured to control the gain control means and the
30 phase control means based on the measured power of the error signal,
wherein the delaying means is configured such that the electrical length of a first path to the error signal generating means via the power amplifier is

substantially the same as the electrical length of a second path to the error signal generating means via the delaying means.

dated this 10 day of April 2014.

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