US Patent 6,230,000 invalidates Nearly All of the ParkerVision Claims-in-Suit

ParkerVision has repeatedly claimed that US Patent 6,230,000 (Tayloe) is a “voltage sampler” and thus does not anticipate the ParkerVision claim-in-suit. This reasoning is more than little confused, in that to invalidate a claim one must only look at the words of the claim, and, as none of the claims-in-suit refer to “voltage sampling” or anything even remotely similar, this ParkerVision argument is both legally and technical meaningless. Nevertheless, I will show that Tayloe is very explicitly not a voltage sampler by any plausible engineering definition.

More importantly, I will also show for a few representative claims-in-suit, that Tayloe explicitly describes every element of each claim as defined by the judge’s Markman, and so each claim in invalid by anticipation.

Tayloe is not a “Voltage Sampler”

A “voltage sampler” is more commonly referred to as “sample and hold”. The usual implementation (Fig 1) uses an input buffer, a switch, a capacitor, and finally an output buffer. The input buffer allows the capacitor to track the input voltage *without drawing current from the input*, as otherwise the capacitor would not accurately track the input voltage (it would instead act as a low pass filter on the voltage.) When the switch opens, the instantaneous voltage on the capacitor is held while the switch is open, and the output buffer allows the voltage to be used without disturbing the energy in the capacitor.

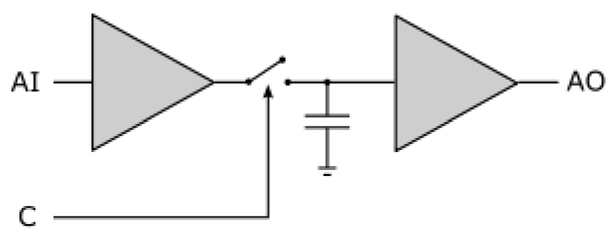
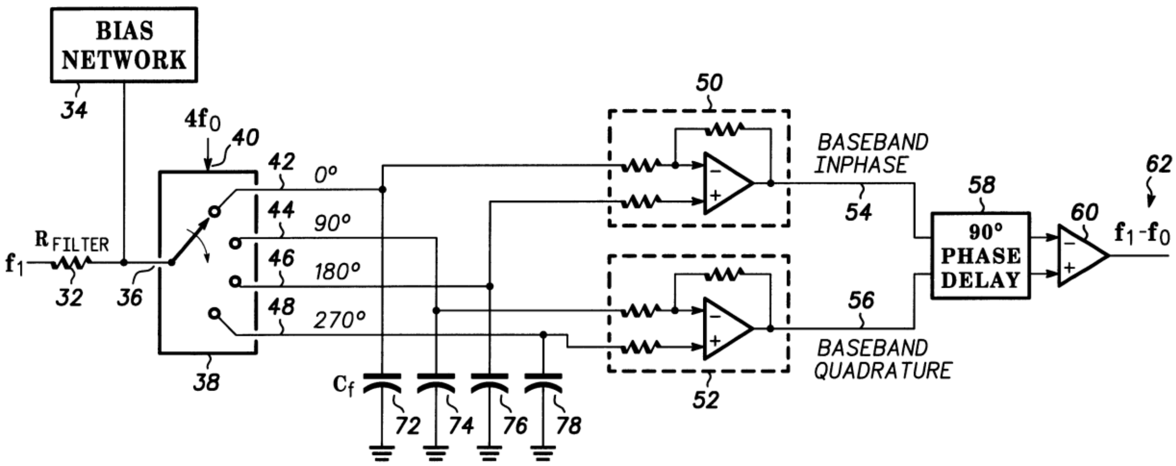


Fig 1

Tayloe (fig 3) implements something quite different (fig 3), and I will show that Tayloe is not a “voltage sampler” by any definition. First of all, there is no input buffer (see fig 3, and this can be inferred from the text “Because the Tayloe Product Detector significantly reduces front end loss, the pre-amplifier and its associated problems may become unnecessary in future direct conversion receiver designs.”), the current required to charge the capacitor comes directly from the RF input signal. With both voltage and current being taken directly from the RF signal, the switch in Tayloe is clearly “transferring non-negligible energy from the carrier signal” and accumulating (or integrating) energy in the capacitor (“Each of the capacitors functions as a separate integrator, each integrating a separate quarter wave of the input signal.”). The capacitor is discharged primarily through the input resistor (the source can charge or discharge the capacitor, as it a relatively low impedance to ground). This accumulation occurs over many carrier cycles (“As commutating switch 38 cycles through the four outputs, capacitors 72-78 charge to voltage values substantially equal to the average value of the input signal during their respective quadrants Each of the capacitors functions as a separate integrator, each integrating a separate quarter wave of the input signal.”), and the number of cycles over which the capacitor "discharges" is the time constant $R_{Filter}*C_f$ (i.e. the product of the input resistor and the accumulating capacitor.) Tayloe is not sampling the input voltage, but is rather accumulating energy over multiple aperture periods in a capacitor.



30 *FIG. 3*

Tayloe shows averaging the signal over a quarter-cycle (90 degrees), during which a given switch (of 4) is open. The input resistance is chosen to be low enough that the input signal is averaged (integrated) over not just one quarter-cycle, but many such cycles "Each of the capacitors functions as a separate integrator, each integrating a separate quarter wave of the input signal.", and "As a result of the operation of product detector 150, baseband in-phase signal 158 and baseband quadrature signal 160 represent integrated samples of the input waveform where the samples have been taken substantially 90 degrees apart."

Finally, Tayloe (and the QCOM QSC6270 which implements Tayloe pretty much exactly) cleverly combines these 4 different averaged values to maximize the efficiency of the transferred energy and to simultaneously generate the IQ signals at baseband (direct conversion). 0deg is combined with inverted 180deg to generate I, and 90deg is combined with inverted 270deg to generate Q. This not only directly anticipates the ParkerVision claims, but implements a more efficient approach to transferring energy than what ParkerVision demonstrates, so that Tayloe is at least a factor of 2 more efficient at transferring and using the input energy than ParkerVision's best examples.

Tayloe is obviously not a "voltage sampler".

Invalidation of Selected ParkerVision Claim-In-Suit by Tayloe

Claim 1 of ParkerVision patent 6,061,551

> 1. A method for down-converting a carrier signal to a lower frequency signal, comprising the steps of:

(1) receiving a carrier signal;

(2) transferring non-negligible amounts of energy from the carrier signal, at an aliasing rate that is substantially equal to a frequency of the carrier signal plus or minus frequency of the lower frequency signal, divided by n, where n represents a harmonic or sub-harmonic of the carrier signal; and

(3) generating a lower frequency signal from the transferred energy.

I will now show that Tayloe contains every element of this claim.

"A method for down-converting a carrier signal to a lower frequency signal" is the whole point of Tayloe e.g., from Tayloe we see "A product detector for converting a signal to baseband….".

"Transferring non-negligible amounts of energy from the carrier signal, at an aliasing rate that is substantially equal to a frequency of the carrier signal plus or minus frequency of the lower frequency signal, divided by n, where n represents a harmonic or sub-harmonic of the carrier signal". As I described above, Tayloe transfers "non-negligible amount of energy from the carrier signal" by any definition of non-negligible, in that Tayloe transfers higher percentage of energy from the carrier than the best mode that ParkerVision describes, and obviously meets the Markman definition of "transferring energy in amounts that are distinguishable from noise." The rest of the claim "at an aliasing rate that is substantially equal to a frequency of the carrier signal plus or minus frequency of the lower frequency signal, divided by n, where n represents a harmonic or sub-harmonic of the carrier signal". Tayloe describes a lower frequency equal to 0 (i.e. the baseband), and n=1, which is allowed in the Markman (ParkerVision fought hard to allow n=1, but allowing n=1 invalidates the claim!)

Finally, "generating a lower frequency signal from the transferred energy" is described in Tayloe as Fig. 3 shows a direct conversion receiver in accordance with a preferred embodiment of the present invention." Both the text and Fig 3 show a circuit that generates the "lower frequency signal from the transferred energy", i.e. the output of Fig 3 is the lower frequency signal.

Thus all elements of claim 1 are present in Tayloe, and thus claim 1 is invalid by anticipation.

Claim 23 of '551

23. An apparatus for down-converting a carrier signal to a lower frequency signal, comprising:

an energy transfer signal generator;

a switch module controlled by said energy transfer signal generator; and

a storage module coupled to said switch module;

> wherein said storage module receives non-negligible amounts of energy transferred from a carrier signal at an aliasing rate that is substantially equal to a frequency of the carrier signal plus or minus a frequency of the lower frequency signal, divided by n where n represents a harmonic or sub-harmonic of the carrier signal, wherein a lower frequency signal is generated from the transferred energy.

This is very similar to claim 1, and so is the analysis.

"An apparatus for down-converting a carrier signal to a lower frequency signal, comprising:" is in Tayloe as I described for claim 1 above.

"an energy transfer signal generator" is in Tayloe, e.g. "the control signal input to control input 40 is substantially equal to four times the local oscillator frequency that would exist in a simple direct conversion receiver."

"a storage module coupled to said switch module" is in Tayloe – any of the storage capacitors in Fig 3 is an example of this.

"wherein said storage module receives non-negligible amounts of energy transferred from a carrier signal at an aliasing rate that is substantially equal to a frequency of the carrier signal plus or minus a frequency of the lower frequency signal, divided by n where n represents a harmonic or sub-harmonic of the carrier signal, wherein a lower frequency signal is generated from the transferred energy." This is in Tayloe using the same analysis as in claim 1 above.

So, it is easy to show that all of the elements of claim 23 are in Tayloe, and thus claim 23 is invalid by anticipation.

All of the asserted claims of the '551 patents are dependent on claim 1 or claim 23 and are all invalid over Tayloe.

Claim 1 of ParkerVision patent 7,724,845

> 1. A method for down-converting an electromagnetic signal, comprising the steps of:
>
> (1) performing with a finite time integrating module a finite time integrating operation on a portion of a carrier signal;
>
> (2) accumulating the result of the finite time integrating operation of step (1); and
>
> (3) repeating steps (1) and (2) for additional portions of the carrier signal, whereby the accumulation results form a down-converted signal.

"A method for down-converting an electromagnetic signal" is clearly disclosed by Tayloe.

“(1) performing with a finite time integrating module a finite time integrating operation on a portion of a carrier signal;”

The court’s Markman ruling defines a finite time integrating module as “convolving a portion of the carrier signal with an impulse response that is a rectangular, triangular, half sine, nearly sinusoidal, or a step function.” Tayloe convolves (i.e. multiplies) the carrier signal with a rectangular function (i.e. it open each switch for a 25% duty cycle, which is the same as convolving with a rectangular 25% duty cycle signal.)

“(2) accumulating the result of the finite time integrating operation of step (1); and” is described in Tayloe in the integration of the outputs of the each switch in the capacitors of fig 3 above, as in “Each of the capacitors functions as a separate integrator, each integrating a separate quarter wave of the input signal.”

“(3) repeating steps (1) and (2) for additional portions of the carrier signal, whereby the accumulation results form a down-converted signal.” This is exactly what is described in Tayloe, which repeats the accumulation over each additional cycle.

Every element of claim 1 of ‘845 is present in Tayloe, and so claim 1 is invalid by anticipation over Tayloe.

Conclusion

The other patents-in-suit have variations on the claims of ‘551, and nearly all of them are invalidated by Tayloe. There are a few claims (generally involving differential circuitry, such as claim 18 of 7,496,342 and various claims of 6,963,734) that are invalid over other prior art (including van Graas90, which includes a differential circuit but is otherwise similar to Tayloe.)

I can find no asserted claims any of the ParkerVision patents that are valid over the prior art mentioned by Qualcomm. Analyzing each claim can be tedious and time-consuming, but I am happy to add specific claims analysis to this paper for any asserted claim of the patents-in-suit on request – just send me an email.

At some point soon, we should be able to see the invalidity analysis of Qualcomm, which will be far more detailed than this short note.