Neutral Citation Number: [2013] EWHC 3247 (Pat)

Case No: HC12A02048, HC12C02909

IN THE HIGH COURT OF JUSTICE
CHANCERY DIVISION
PATENTS COURT

Royal Courts of Justice, Rolls Building
Fetter Lane, London, EC4A 1NL

Date: 30 October 2013

Before :

THE HON MR JUSTICE ARNOLD

- -

Between :

HTC CORPORATION	**Claimant**
- and -	
NOKIA CORPORATION	**Defendant**

- -
- -

Guy Burkill QC, **Brian Nicholson** and **Alexander Milner** (instructed by **Hogan Lovells International LLP**) for the **Claimant**
Michael Tappin QC, **Nicholas Saunders** and **Miles Copeland** (instructed by **Bird & Bird LLP**) for the **Defendant**

Hearing dates: 7-11 October 2013

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Approved Judgment without Confidential Annexes

I direct that pursuant to CPR PD 39A para 6.1 no official shorthand note shall be taken of this Judgment and that copies of this version as handed down may be treated as authentic.

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THE HON MR JUSTICE ARNOLD

MR JUSTICE ARNOLD :

Contents

Introduction

1. The Defendant ("Nokia") contends that the Claimant ("HTC") has infringed European Patent (UK) No. 0 998 024 entitled "Modulator structure for a transmitter and a mobile station" ("the Patent"). HTC denies infringement both on the ground that the accused products do not fall within the claims and on the ground that they are licensed. As explained below, discussion of the non-infringement defences is complicated by confidentiality considerations. HTC also contends that the Patent is invalid on the grounds that the claims lack novelty or are obvious over US Patent No. 5,469,092 ("Itakura"), alternatively are obvious over International Patent Application No. WO 97/42554 ("Tan"). There is no challenge to the Patent's claimed priority date of 30 October 1998.

The witnesses

Technical experts

2. Nokia's technical expert was Professor Bram Nauta. Prof Nauta is head of the Integrated Circuit (IC) Design group at the University of Twente in the Netherlands. Prof Nauta obtained an MSc in Electrical Engineering from the University of Twente in 1987 and a PhD in analogue CMOS filters for very high frequencies from the same university in 1991. From 1991 until 1998 he worked in the Mixed-Signal Circuits and Systems Department at Philips Research. In 1998 he took up his current position. He has sat on the editorial board of two Institute of Electrical and Electronic Engineers publications, is a member of two Technical Program Committees for industry conferences and has twice won an outstanding paper award.

3. Despite the handicap of giving evidence in English which was good but not perfect, Prof Nauta was an impressive witness. He had complete command of the subject matter and was able to explain and support what he had written in his reports with very few qualifications. Counsel for HTC relied on the fact that it turned out that Prof Nauta had no personal experience of working on Gilbert cell modulators in 1998. As Prof Nauta made clear, however, he was familiar with such circuits and did have experience of high speed circuits generally.

4. HTC's technical expert was James Crawford. Mr Crawford has been an independent technical consultant in the field of radio frequency (RF) systems design and frequency synthesis since 1990. He obtained a BSc in Electrical Engineering from the University of Nebraska in 1976 and an MSc in Quantum Electronics from the University of Southern California in 1979. He worked for Hughes Aircraft Company until 1985 and then a number of small, high-tech start-up companies before becoming an independent consultant. His experience since includes working as the lead RF systems architect for both a 900 MHz specialised mobile radio handheld product and 450 MHz commercial mobile phone in 1994-96 and as the RFIC system architect for a cellular telephone chipset in 1998. Nevertheless, it turned out that he had not worked on an

RFIC modulator until 2005. Thus, like Prof Nauta, he did not correspond precisely to the skilled person; but, like Prof Nauta, he was nevertheless well qualified to give evidence in this case.

5. Mr Crawford did his best to assist the court in his oral evidence. Nevertheless, I found him a much less impressive witness than Prof Nauta. He was forced to retract certain points he had made in earlier reports in his seventh report, and to make further significant qualifications to his reports in cross-examination. Even where he did not retract or qualify his evidence, he was less able convincingly to support what he had written. Furthermore, it became apparent that he had been instructed in a manner which was calculated to induce hindsight. Initially he was provided with the Patent and some prior art. To begin with, he focussed on the Patent and wrote a critique of it which he accepted accentuated the negative over the positive. Only subsequently did he focus on the prior art, but even then he understood from his instructions that he was only to consider parts of Itakura. As a result, he only considered the document as a whole a couple of weeks before trial. This also led him to make an unedifying attempt during cross-examination to support his evidence by repeated references to Fig. 21 of Itakura, when no previous mention had been made of it by anyone (and it was not relied upon by counsel for HTC in closing submissions either).

Experts on US law

6. Nokia's expert on US law was Professor Timothy Holbrook. Prof Holbrook is Associate Dean of Faculty and Professor of Law at Emory University School of Law in Atlanta, Georgia. Prof Holbrook obtained his law degree in 1996 from Yale and then became a law clerk for the Hon. Glenn Archer at the US Court of Appeals for the Federal Circuit. He practised as a patent litigation attorney until 2000 before embarking on his academic career. His teaching focuses on intellectual property and in particular patent law. He has published extensively on matters of patent law, including in matters of the territorial reach of US patent law, and his publications have been cited favourably by the Federal Circuit and several federal district courts.

7. HTC's expert on US law was Professor Jason Schultz. Prof Schultz is Associate Professor of Clinical Law and Director of the Technology Law & Policy Clinic at New York University School of Law. Prof Schultz obtained a BA in Public Policy in 1993 and his law degree in 2000. He was an IP litigation associate for a firm in California for two years before becoming a staff attorney at the Electronic Frontier Foundation for four years. He then became an Assistant Clinical Professor of Law at the University of California, Berkeley before moving this summer to New York University.

8. Sensibly, the reports were served sequentially, with Prof Schultz's first report being served first. Equally sensibly, at my suggestion, the parties agreed to dispense with cross-examination of the experts.

<u>Technical background</u>

9. There is a considerable amount of technical background to this case which is set out in the reports of Mr Crawford and Prof Nauta. Much of this technical background is not only common ground, but is also quite detailed and not essential to an

understanding of the issues between the parties. Accordingly, I shall concentrate on those aspects of the technical background which are directly relevant to the issues.

Mobile telephone networks

10. The invention described and claimed in the Patent is not limited to mobile telephone networks, but it is of particular application in such networks. The Patent refers to three mobile network standards: GSM (Global System for Mobile Communications), PCN (Personal Communication Network) and PCS (Personal Communication System). These are all digital networks in which the information to be transmitted is digital data. GSM and PCN are standards for second generation (2G) cellular networks. These supported multiple simultaneous users by dividing the radio frequency space into narrow frequency channels (Frequency Division Multiple Access or FDMA) and time slots (Time Division Multiple Access or TDMA). 2G mobile phones were commercially available in October 1998. At that time, work was underway on the third generation (3G) standard UMTS (Universal Mobile Telecommunications System), which supported multiple users by a code channel scheme called Wideband Code Division Multiple Access or WCDMA, but the first set of specifications was not adopted until the end of 1999.

Transceivers

11. Mobile phones incorporate transceivers which both transmit and receive RF signals. There are two types of transceiver design, referred to as "direct conversion" and "superheterodyne". I will explain the difference below.

Modulation

12. Modulation is the act of impressing useful information upon an otherwise unchanging sinusoidal carrier signal. There are a number of different methods of modulation. Amplitude modulation (as in AM radio) involves varying the amplitude of the carrier signal. Frequency modulation (as in FM radio) involves varying the frequency of the carrier signal. Phase modulation involves varying the phase of the carrier signal. If the information is digital, then a digital modulation method will be required. Digital modulation may involve either stepping between discrete values of the carrier signal (as in Amplitude-Shift Keying, Frequency-Shift Keying and Phase-Shift Keying) or continuously modifying it (as in Continuous Phase Modification).

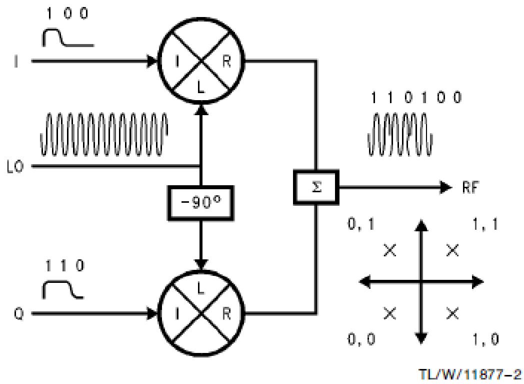
13. Modulation may be performed using a mixer, which is a form of analogue multiplier suitable for RF signals. This converts information from one part of the frequency spectrum to another. In up conversion information is converted from a lower baseband frequency to a higher RF frequency for transmission. In down conversion the process is reversed for reception. In both up conversion and down conversion the transmit or receive signal, as the case may be, is mixed with a local oscillator (LO) signal. In a direct conversion transceiver this is done in a single mixing step. In a superheterodyne transceiver it is done in more than one step. Thus in the transmit chain the signal is converted from baseband to an intermediate frequency or IF (or more than one IF) and then to RF.

14. When a signal centred on a radio frequency is down-converted from that frequency to 0 Hz, the part of the signal that was below the RF centre frequency is folded towards

negative frequencies. This is represented by a complex representation involving a "real" and "imaginary" signal (like real and imaginary numbers). This is done by mixing the receive signal with two LO signals of the same frequency, but 90 degrees out of phase: the I ("in phase") and Q ("quadrature") signals. The same process is used in reverse in transmission.

IQ modulators

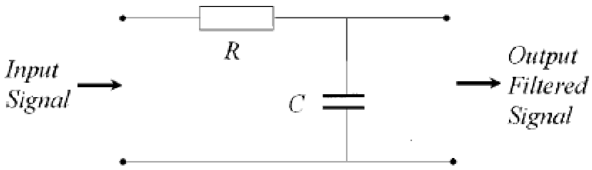
15. There are many types of modulators, but the present case is mostly concerned with IQ modulators, which were well known and had been already widely adopted in standards-based mobile phones by October 1998. An IQ modulator is shown schematically in National Semiconductor's Application Note 889 dated October 1993 which I reproduce below:



16. In this arrangement I and Q are the information signals (or parts of the information signal). They are combined with the carrier signal LO in two multipliers and summed to create the final RF signal.

Low-pass filters

17. A low-pass filter allows low frequency signals to pass through it, but attenuates higher frequencies. It may be contrasted with a high-pass filter, which allows high frequencies to pass through; and a band-pass filter, which allows frequencies within a range to pass through. The simplest kind of low-pass filter is an RC (resistor-capacitor) filter:



18. In conceptual (and grossly simplified) terms, a capacitor passes high frequencies more readily than low frequencies. So higher frequencies are "short circuited away" and disappear down through the capacitor, while lower frequencies are not and so proceed to the output. The component values chosen for R and C set the "cut-off frequency", above which the filtering is significant. It should be appreciated that the filter does not literally cut-off the signal above this frequency (i.e. reduce it to zero). Rather, there is an attenuation of the signal, and the degree of attenuation increases with increasing

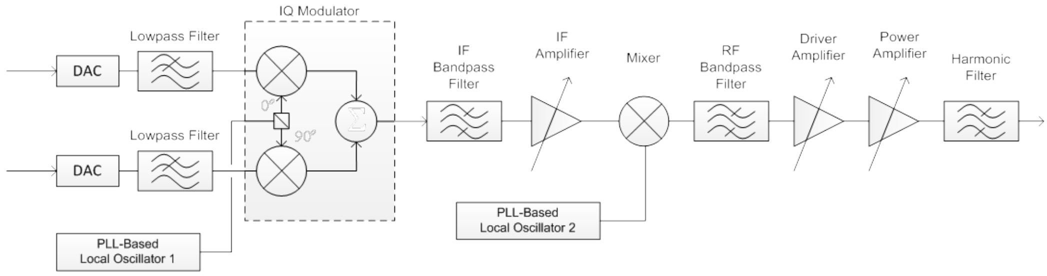
frequency. The steepness of the slope can be increased by combining filters to produce a second-order filter, a third-order filter and so on.

Anti-aliasing filters

19. An anti-aliasing filter is a filter used before a signal sampler in order to restrict the bandwidth of the signal so as (approximately) to satisfy the sampling theorem. The sampling theorem is what underpins the sampling of analogue signals in order to turn them into digital signals. Aliasing refers to an effect that causes different frequency signals to become indistinguishable (or aliases of one another) when sampled. The sampling theorem states that unambiguous interpretation of the signal from its samples is possible when the power of frequencies above a frequency called the Nyquist frequency is zero. In reality, anti-aliasing filters do not entirely eliminate aliasing.

Transmit chain architecture

20. In the early 1990s, standards-compliant mobile phones had superheterodyne transceivers. One reason that this was beneficial is that it enabled an intermediate filtering stage using a SAW (surface acoustic wave) filter to be inserted. The transmit chain was then as shown schematically in Figure 13 of Mr Crawford's first report, which I reproduce below (the IF bandpass filter is a SAW filter):



21. This shows the I and Q components of the baseband signal passing through a digital-to-analogue converter (DAC) and a low-pass filter into an IQ modulator where they are mixed with the LO (which involves a phase-locked loop or PLL) and summed. The output passes through an IF band-pass filter and IF amplifier. There is then a second modulation step before the output passes though the driver amplifier, power amplifier and harmonic filter on the way to the antenna.

22. By 1998, mobile phones had begun to move to direct conversion, the relevant standards having been designed with sufficient margin to enable this. The transmit chain was then as shown schematically in Figure 14 of Mr Crawford's first report:

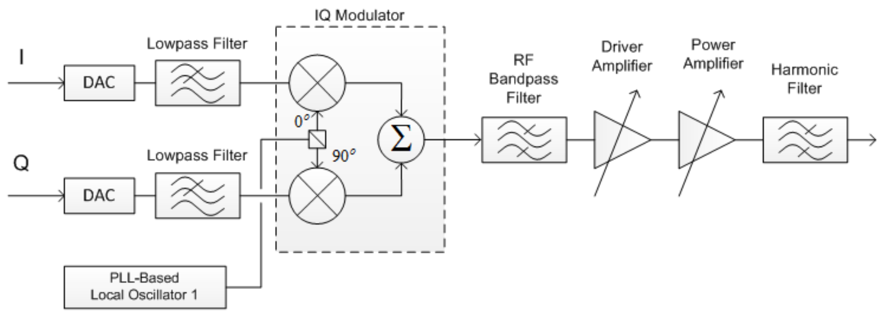


Figure 14 Representative direct-conversion cellular phone transmit-chain from the late 1990s

23. As can be seen, the difference between Figure 13 and Figure 14 is that the latter omits the second modulation step.

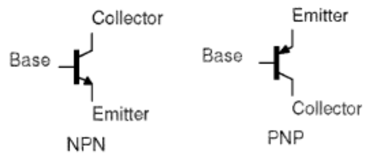
Filtering prior to modulation

24. It is common ground that in 1998 it was conventional to filter the baseband signal using a low-pass filter after the DAC and before the modulator, as shown in Figure 14 above. It was also common to filter before and/or after the driver amplifier as well as after the power amplifier.

Transistors

25. There are two main types of transistors, the BJT (bipolar junction transistor) and the FET (field effect transistor).

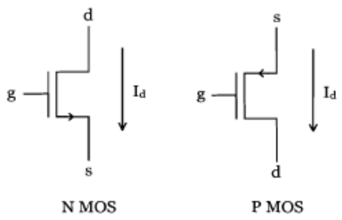
26. There are two kinds of bipolar junction transistors, NPN and PNP, which are drawn in circuit diagrams like this:



In simple terms, a voltage applied at the base with respect to the emitter will allow a current to flow between collector and emitter.

27. There are also two kinds of field effect transistors, N-channel and P-channel. FETs are usually fabricated using MOS ("metal oxide semiconductor") technology (and hence are sometimes referred to as MOSFETs). They are then also referred to as NMOS and PMOS transistors. CMOS ("Complementary MOS") was and is the technology of choice for integrated circuits. A CMOS IC uses both NMOS and PMOS components.

28. FETs are drawn like this:



29. Again, to simplify, a voltage applied at the gate (g) will allow a current to flow between source (s) and drain (d).

30. A significant difference between BJTs and FETs is that BJTs will draw a small current at the base, whereas there is essentially no current flow through the gate of a FET.

31. FETs in particular will inherently exhibit some capacitance between the gate and the other terminals. This is sometimes called "parasitic" capacitance and it can be a nuisance. It can also be exploited, however.

32. Either type of transistor can be used in switching or in analogue mode. In switching mode, a voltage at the base allows current to flow between emitter and collector (bipolar), or a voltage at the gate allows current to flow between source and drain (FET). The transistor can therefore be switched on (conducting) or off (non-conducting).

33. In analogue mode, the controlling voltage at the base (bipolar) or gate (FET) is variable and the transistor will then act as a voltage-controlled current source. The current passing through the device will vary depending on the control voltage applied. This is shown in Figure 14 to Prof Nauta's first report, which I reproduce below:

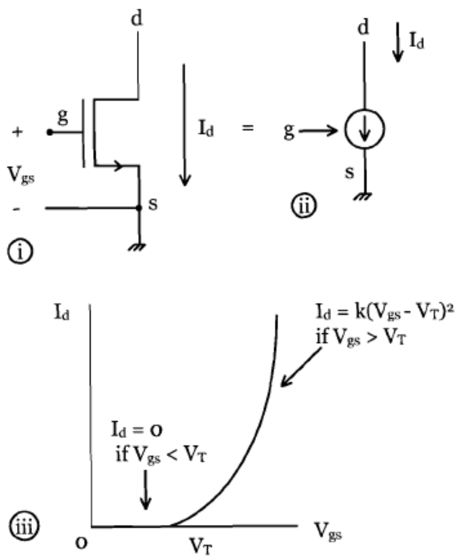


Figure 14: The NMOS transistor acting as voltage controlled current source

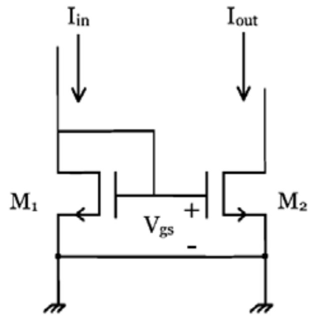
34. If V_{gs} is smaller than the threshold voltage (V_T) then no current flows, but if V_{gs} is larger than V_T then current I_d flows through the transistor. Thus, above V_T, V_{gs} is related to the current I_d flowing through the transistor, and vice versa. The

relationship is not a linear one, however. Both the current mirror and the Gilbert cell (as to which, see below) rely on this principle.

35. Transistors may need biasing in order to set them up into their working region. How to do so was well known in 1998 and the need for it was frequently left implicit.

Current mirrors

36. The basic design of a current mirror fabricated using NMOS FETs is shown below:



37. The gates of the two FETs are directly connected and there is a feedback loop between the gate and the drain of the input transistor M_1. The operation of such a current mirror can be explained as follows. Assume that input current I_{in} flows from the power supply towards transistor M_1. If V_{gs} at M_1 is such that the current which will actually flow through M_1 is less than I_{in} then the voltage at the node above M_1 will rise. As a result of the feedback loop, this also results in the voltage at the gate of M_1 rising. Accordingly V_{gs} across M_1 rises, thus "opening" the gate of the transistor, allowing more current to flow through it, decreasing the voltage at the node above M_1 and hence also at the gate, bringing the transistor to equilibrium. Thus changes in the input current are converted into a fluctuating voltage at the gate of M_1. That fluctuating voltage also acts on the gate of M_2 controlling the output current I_{out} flowing through M_2. Accordingly, I_{out} will mirror I_{in}.

38. Current mirrors were widely used in 1998. Their uses included:

i) "folding" a circuit to avoid "stacking" of multiple levels of components, and so allow it to use a lower voltage power supply;

ii) biasing (setting up components to their operating condition); and

iii) duplicating a current which has different associated voltages.

Gilbert cells

39. In analogue signal processing, the need often arises for a circuit that takes two analogue inputs and produces an output proportional to their product, Such circuits are termed analogue multipliers. A simple form of analogue multiplier is an emitter-coupled pair of BJTs, as shown in Figure 10.6 of the standard work *Analysis and Design of Analog Integrated Circuits* by Paul Gray and Robert Meyer (3rd ed, 1993) which I reproduce below:

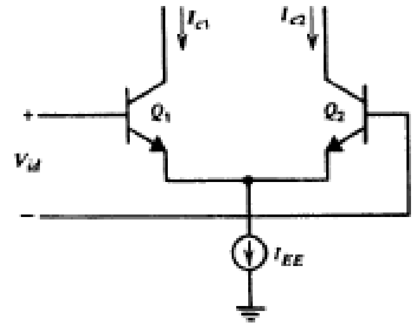


Figure 10.6. Emitter-coupled pair.

40. The Gilbert cell is a modification of the emitter-coupled cell published by Barrie Gilbert in 1968 which allows four-quadrant multiplication. The basic circuit is shown in Figure 10.9 of Gray & Meyer:

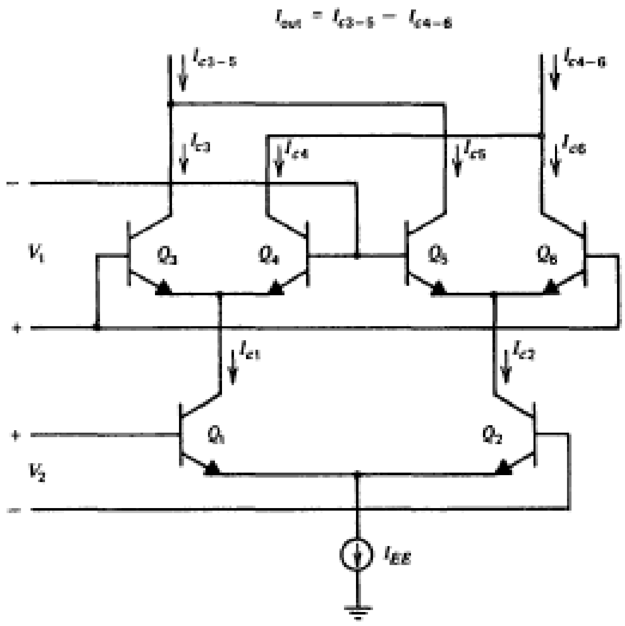


Figure 10.9 Gilbert multiplier circuit.

41. The arrangement shown comprises an emitter coupled pair of transistors (Q1 and Q2) connected in series with two cross-coupled emitter-coupled pairs (Q3 and Q4, Q5 and Q6) i.e. a total of six transistors. In this arrangement Q3-Q6 multiply the differential current signal converted from the differential voltage input V_2 by Q1-Q2 by a factor proportional to the differential voltage input V_1. As I shall explain, however, it is not essential to have six transistors. Although this figure shows BJTs, Gilbert cells can also be implemented in CMOS.

42. Gray & Meyer outline the applications of the Gilbert cell as follows at page 672:

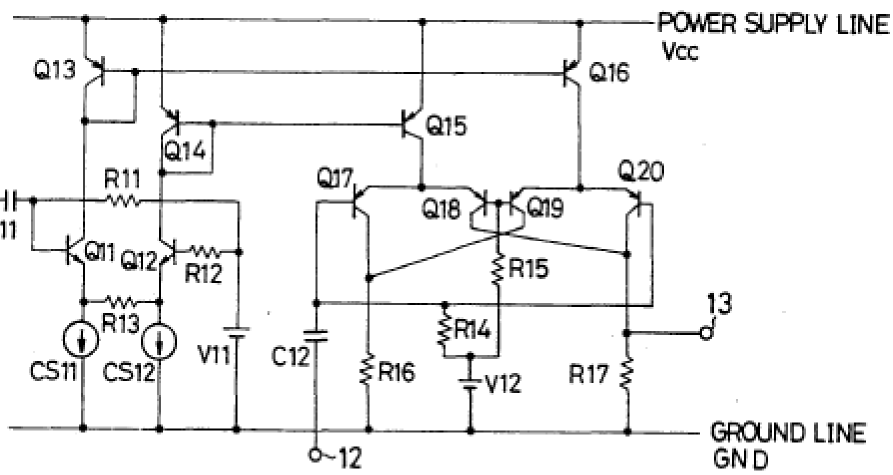
> Practical applications of the multiplier cell can be divided into three categories according to the magnitude relative to V_T of applied signals V_1 and V_2. If the magnitude of V_1 and V_2 are kept small with respect to V_T, the hyperbolic tangent function can be approximated as linear and the circuit behaves as a multiplier, developing the product of V_1 and V_2. However, by including nonlinearity to compensate for the hyperbolic tangent function in series with each input, the range of input voltages over which linearity is maintained can be greatly extended. This technique is used in so-called four-quadrant analog multipliers.
>
> The second class of applications is distinguished by the application to one of the inputs of a signal that is large compared to V_T, causing the transistors to which that signal is applied to behave like switches rather than near-linear devices. This effectively multiplies the applied small signal by a square wave, and in this mode of operation the circuit acts as a modulator.
>
> In the third class of applications, the signals applied to both inputs are large compared to V_T, and all six transistors in the circuit behave as nonsaturating switches. This mode of operation is useful for the detection of phase differences between two amplitude-limited signals, as is required in phase-locked loops, and is sometimes called the phase-detector mode.

43. As this passage makes clear, the Gilbert cell can be used in different ways, depending on the surrounding circuitry.

44. Gray & Meyer go on at pages 672-675 to say that, when the Gilbert cell is being used as a multiplier, larger signals can be accommodated either by including degeneration resistors or by introducing a non-linearity that compensates for the non-linearity of the transistors Q1 and Q2. As they explain, if the latter approach is adopted, one can dispense with transistors Q1 and Q2 altogether. A complete four-quadrant multiplier following this approach is described and illustrated at pages 675-676. They then explain at pages 677-679 how such a four-quadrant multiplier can be used as a modulator.

Gilbert cells with current mirrors

45. As will appear, the Patent acknowledges at [0009] that United States Patent No. 5,172,079 (“079”) describes a modulator using a Gilbert cell with current mirrors in its driving arrangement. I reproduce Figure 2 of 079 below:



46. Q17-Q20 are the cross-coupled, emitter-coupled pairs of transistors of the Gilbert cell and Q11/Q12 are the other emitter-coupled pair. There are two current mirrors, Q13/Q16 and Q14/Q15.

47. A Gilbert cell with current mirrors in its driving arrangement is also shown in Figure 2 of Itakura, which Itakura describes as conventional:

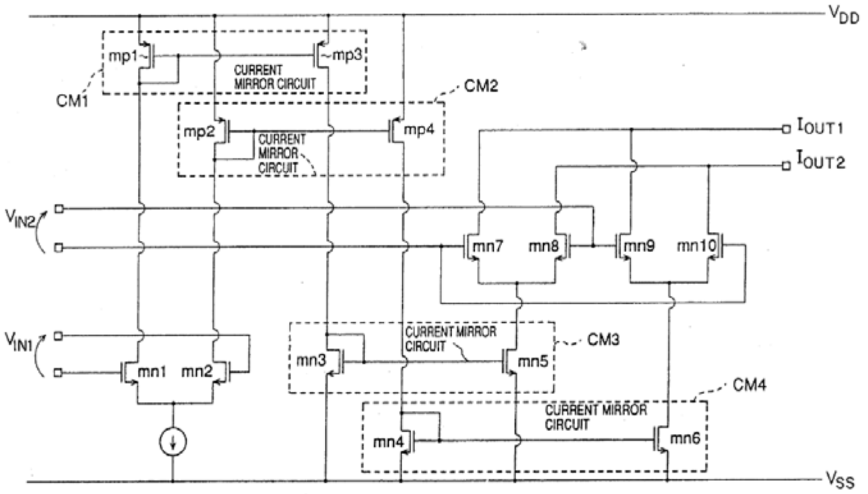


FIG. 2
PRIOR ART

48. This has four sets of current mirrors marked CM1-CM4 consisting of FETs mp1/mp3, mp2/mp4, mn3/mn5 and mn4/mn6. These are used to "fold" the circuit, so as to avoid "stacking" and enable a lower voltage power supply to be used. FETs mn7-mn10 are the cross-coupled, emitter-coupled pairs of transistors of the Gilbert cell, while FETs mn1/mn2 are the other emitter-coupled pair.

The Patent

49. The specification begins at [0001] by saying that the invention relates in general to modulators, and in particular to a modulator structure which is suitable for dual-band or triple-band mobile stations. The specification explains what is meant by "dual-band" and "triple-band" in [0018] (quoted below). The specification does not explain precisely what it means by "mobile stations", but some indication is provided by Figure 7 (as to which, see below).

50. The specification then states at [0002]:

> "In modulation a carrier frequency is modified in a certain way so that the data to be transmitted using the radio signal is carried, for example, in the changes of the phase or amplitude of the carrier frequency. There are many modulation methods, which differ in the sense which properties of the carrier wave are modulated and how they are modulated. The arrangement that performs the modification of the carrier wave is called a modulator. There are also many types of modulators. A direct conversion modulator, for example, may be used in mobile stations. In a direct conversion modulator the modulation is performed directly in the carrier frequency; there is no intermediate frequency in the modulation process."

51. It goes on at [0003]-[0004] to say that the most important characteristics of a modulator are the linearity and the signal-to-noise ratio in the transmit (TX) frequency band and in the receive (RX) frequency band. It notes that, although the noise in the RX band can be improved by filtering the modulated signal, it is not possible to filter the noise in the TX band after modulation (i.e. because a filter would remove the desired signal as well as the noise). It says that filtering at the RX range is usually done using a low-pass filter after the power amplification.

52. The specification sets out in [0004]-[0005] and Table 1 the signal-to-noise ratio limits for noise generated in the RX band by the transmitter at maximum power for the GSM, PCN and PCS standards; but it is common ground that nothing turns on these figures.

53. In [0007] the specification says that Figure 1 shows the basic effect of a low-pass filter on radio signals:

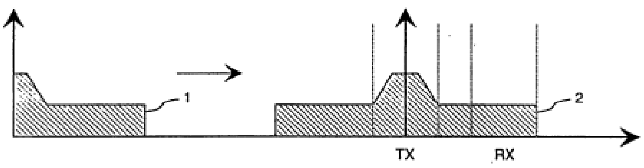


FIGURE 1A

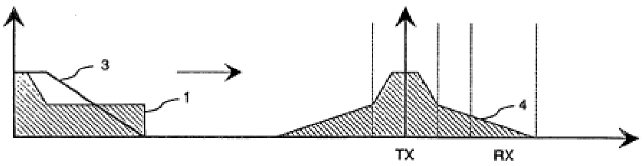


FIGURE 1B

54. In Figure 1A the transmit signal 1 is mirrored over the modulated centre frequency. The result 2 extends into both the TX range and the RX range. Figure 1B shows the effect of applying a filter function 3: the signal is mainly concentrated in the TX range and only extends slightly into the RX range. Thus the noise in the RX band caused by the transmitter is reduced.

55. The specification then introduces Gilbert cells as follows:

> "[0008] Previously there is also known a so called Gilbert cell, which is generally used in integrated multiplicator circuits of telecommunication systems, particularly in mobile stations. Multiplicator circuits are used for instance in integrated RF (radio frequency) and intermediate frequency sections, such as in the modulator, the mixer and the regulated amplifier.
>
> [0009] US patent US 5,172,079 describes a modulator using a Gilbert cell with current mirrors in its driving arrangement."

It is common ground that [0008] should more accurately refer to multiplier circuits.

56. After a discussion of the mathematics of a multiplier, the specification describes at [0015] a known Gilbert cell shown in Figure 2:

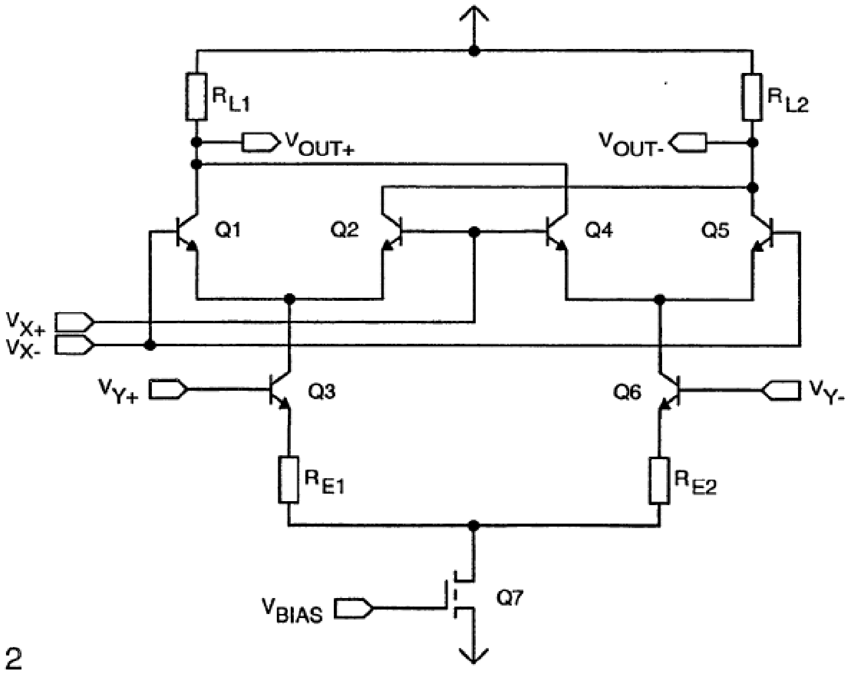


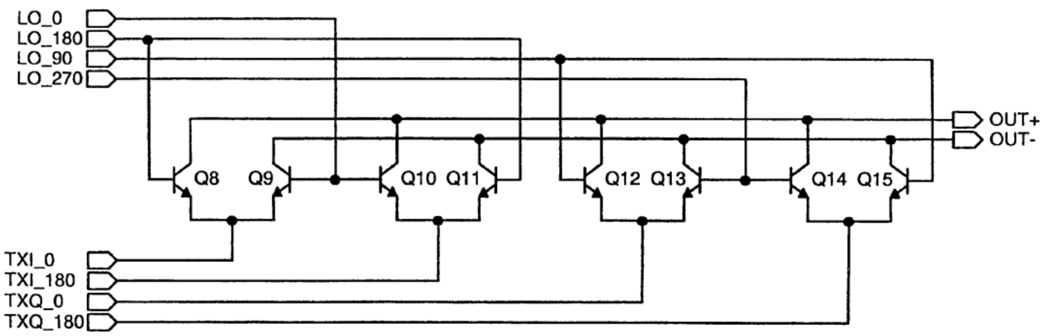
FIGURE 2

57. This is essentially the same as the Gilbert cell shown in Figure 10.9 of Gray & Meyer with the addition of a biasing arrangement at the bottom, degeneration resistors R_{E1} and R_{E2} and a load circuit consisting of resistors R_{L1} and R_{L2} which converts the resulting differential current into a differential voltage output V_{OUT+}/V_{OUT-}.

58. In [0016] the specification states that:

> "Figure 3 shows the circuit arrangement of the switch transistors in a direct conversion modulator. The arrangement comprising the switch transistors is often called the switching arrangement or switching block of a modulator."

59. I reproduce Figure 3 below:



60. This circuit has four pairs of transistors Q8/Q9, Q10/Q11, Q12/Q13 and Q14/ Q15. Transmit signals TXI_0 and TXI_180 (I signals with opposite phases) and TXQ_0 and TXQ_180 (Q signals with opposite phases) are supplied to the emitters of the transistors, while four differently phased signals LO_0, LO_180, LO_90 and LO_270 from the local oscillator are supplied as control signals. The output is signals OUT+ and OUT-.

61. The specification then describes the problems which the invention aims to solve as follows:

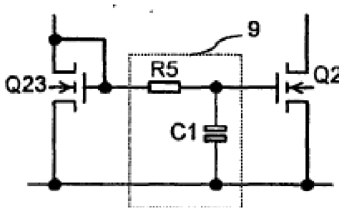
> "[0018] A problem in known devices is that a mobile station operating at two or three frequency bands, i.e. a dual-band or triple-band mobile station, requires many filters, which occupy too much space in a mobile station. In practice the realization of a small-sized RF section in this way is impracticable, and therefore there is a tendency to avoid filtering. However, when filtering is omitted the modulator must be of a particularly high quality.
>
> [0019] A further problem of known devices is that they require separate filters between the modulator and the transmitter.
>
> [0020] Against this background, the invention resides in minimizing in the modulator the noise accumulated to the modulated signal."

62. The advantages of the invention are further explained as follows:

> "[0024] The noise that a modulator causes to the receiver frequency range comprises the noise of the switch transistors in the modulator, the noise of the local oscillator, and the noise of the signal carrying the information to be transmitted. In a balanced modulator structure the noise due to the switch transistors is dampened so that it is not the dominating component in noise. Current state-of-the-art bipolar transistors nowadays usually have low enough noise level.
>
> [0025] The noise in the information signal can be a dominating factor, especially in direct conversion modulators. Therefore it is advantageous to filter the possible noise component away from the signal carrying the information to be transmitted. In a modulator according to the invention, this filtering is carried out in the modulator.
>
> [0026] A modulator here refers to an arrangement where the information signal, i.e. the signal carrying the data to be transmitted, and the signal having the carrier frequency interact. …"

63. Specific embodiments of the invention are described at [0035]-[0045] by reference to Figures 4-7. Figure 4 shows a highly schematic drawing of a modulator. The modulator is shown as including within it both a switching arrangement and a driver arrangement, the latter of which in turn includes a filter arrangement. The details of these arrangements are not shown.

64. Figure 6 is a circuit diagram of the key feature of the claimed invention:



This shows a current mirror consisting of a pair of transistors Q23 and Q24 and a low-pass filter in box 9 consisting of resistor R5 and capacitor C1.

65. Figure 5 is a circuit diagram of a direct conversion modulator which is a preferred embodiment of the invention that is described at [0040]-[0042]. In the Patent the diagram is split into two halves, Figures 5A and 5B. I reproduce as Annex 1 to this judgment Figure 28 to Prof Nauta’s first report which helpfully joins the two halves together by means of dotted lines and colour codes the different parts of the circuit as follows: the driver arrangement in green, the current mirrors in pink, the low-pass filters in orange and the switching arrangement in blue.

66. The switching arrangement comprising switch transistors 8 in Figure 5B is essentially the same as in Figure 3.

67. If one compares the driving arrangement with Figure 2, it is first necessary to appreciate that Figure 5 is the other way up. The bias arrangement is at the top of the circuit, in Figure 5A, together with what the specification describes as current mirror 5 and control arrangement 6. Since the transmit signal has both I and Q phase components, there are four pairs of transistors (Q23/Q24, Q25/Q26, Q27/Q28 and Q29/Q30) forming current mirrors 7. The specification states at the end of [0040] that these “present an example of driver components in a driver arrangement 420 in Figure 4”. In addition, Figure 5 is implemented in CMOS, whereas Figure 2 is bipolar. These differences are not material to the invention, however.

68. The key difference between Figure 5 and Figure 2 is that the driving arrangement includes four low-pass filters (R5 and C1, R6 and C2, R7 and C3 and R8 and C4) between the transistors of the current mirrors which filter the high frequency noise of the information signal. This late filtering enables a high signal-to-noise ratio to be achieved in the transmit signal.

69. Figure 7 is a highly schematic diagram of a mobile station utilising the invention. This is shown and described as comprising a processor, memory, a display, a keyboard, audio block with microphone and speaker and a transceiver.

<u>The claims</u>

70. Broken down into integers, claim 1 is as follows:

“[A] A modulator using a Gilbert cell, the modulator comprising

[B] a switching arrangement for coupling a carrier wave to the modulator

[C] and a driver arrangement to couple an information signal to the modulator

[D] wherein said driver arrangement comprises current mirrors and at least one of said current mirrors comprises a pair of transistors

[E] **characterised by** at least one low-pass filter arrangement located between the pair of transistors to filter the information signal to the modulator before the information signal is mixed with the carrier wave."

71. Claims 6 and 7 are as follows:

"6. A modulator according to claim 1, comprising a direct conversion modulator.

7. A mobile station comprising a transceiver having a modulator according to any one of claims 1-6."

The person skilled in the art

72. A patent specification is addressed to those likely to have a practical interest in the subject matter of the invention, and such persons are those with practical knowledge and experience of the kind of work in which the invention is intended to be used. The addressee comes to a reading of the specification with the common general knowledge of persons skilled in the relevant art, and he (or she) reads it knowing that its purpose is to describe and demarcate an invention. He is unimaginative and has no inventive capacity. In some cases, the patent may be addressed to a team of persons having different skills.

73. By the end of the trial, it was common ground that, although the claims extend more broadly, the issues in the present case may be assessed from the perspective of a skilled person consisting of an engineer who was seeking to design or improve a direct conversion modulator for a mobile phone in October 1998. There is little dispute as to the attributes of such a person. He would typically have a BSc or BEng degree in electrical or electronic engineering and might also have a Master's degree. He would be likely to have a few years' experience in designing parts of RF transceivers. Although he would concentrate on the modulator, he would need to have an overview of the whole transmit chain.

Common general knowledge

74. I reviewed the law as to common general knowledge in *KCI Licensing Inc v Smith & Nephew plc* [2010] EWHC 1487 (Pat), [2010] FSR 31 at [105]-[115]. That statement of the law was approved by the Court of Appeal [2010] EWCA Civ 1260, [2011] FSR 8 at [6].

75. There is no dispute that everything I have set out in the technical background section of this judgment formed part of the skilled person's common general knowledge (except that there is no evidence that 079 or Itakura were themselves common general knowledge). The only topic on which it is necessary to say anything more is the skilled person's mindset. As counsel for Nokia pointed out, Mr Crawford's approach to the question of obviousness in his reports was predicated upon the skilled person

having a particular mindset. In essence, this consisted of a close focus on improving the noise performance of a direct conversion IQ modulator. Counsel for Nokia submitted that neither the existence, nor the relevance, of such a mindset was established on the evidence. I agree with this.

Construction

76. The general principles applicable to the construction of patent claims were summarised by Jacob LJ in *Virgin Atlantic Airways Ltd v Premium Aircraft Interiors UK Ltd* [2009] EWCA Civ 1062, [2010] RPC 8 at [5].

Claim 1: general points

77. Before turning to the issues on construction, it is convenient to note certain general points which are not in dispute. First, claim 1 is a product claim, not a method claim. Secondly, it follows that "for" in integer [B] must be understood as meaning "suitable for". Similarly, integer [C] must be understood as meaning "suitable to couple". Thirdly, the wording "to the modulator" in integers [B] and [C] is not very felicitous, but this causes no real difficulty. Fourthly, the pre-characterising portion of the claim is based on 079. Fifthly, claim 1 is not limited to any particular type of modulation, nor to any particular implementation (i.e. bipolar or CMOS or mixed), nor to any particular frequency range (whether for the information signal or the carrier wave), nor to any particular noise characteristics.

A modulator

78. There is a small, but nevertheless important, dispute as to the meaning of the word modulator. This is a term of art, and therefore expert evidence is admissible as to its meaning. Both Mr Crawford and Prof Nauta addressed this question in their evidence. There was little difference between them, and I have summarised the effect of their evidence above.

79. As both counsel accepted, however, the Patent also provides its own dictionary in [0026] (quoted in paragraph 62 above), where it defines a modulator as "an arrangement where the information signal … and the signal having the carrier frequency interact". As it happens, there is little, if any, difference between this definition and the ordinary meaning of the word as a term of art; but if there is any difference, it is the definition in the Patent that should be given effect to.

80. The issue is how one decides whether a particular circuit is a modulator rather than a multiplier or phase detector. HTC contends that, given that claim 1 is a product claim, this requires consideration of the circuit in question *qua* product. Accordingly, HTC contends that, if a particular circuit is suitable to act as a modulator under appropriate conditions, it is a modulator. Nokia contends that the question is how the skilled person would regard the circuit, and that how the skilled person would regard a circuit would depend on the context. If, in context, the skilled person would regard a circuit as a modulator, then it is a modulator for the purposes of the claim. If, on the other hand, the skilled person would not regard it as a modulator, then it is not a modulator for the purposes of the claim, even if it would be capable of functioning as a modulator in a different context. As will become apparent, this issue has particular relevance to HTC's case that claim 1 lacks novelty over Itakura.

81. I prefer Nokia's construction. It is clear from Gray & Meyer that essentially the same circuit may be used as a multiplier, a modulator or a phase detector. That does not mean that the skilled person would think that there no is difference between a multiplier, a modulator and a phase detector. How the circuit will be regarded will depend on the context, and in particular the surrounding circuitry.

A modulator using a Gilbert cell, the modulator comprising

82. Counsel for HTC emphasised that the claim requires that the modulator comprises both a switching arrangement and a driving arrangement. Counsel for Nokia did not dispute this. Counsel for HTC submitted that it followed that the Gilbert cell must comprise both a switching arrangement and a driving arrangement. Counsel for Nokia did dispute this. In my judgment, this is not a requirement of the claim. It is not what the words of integer [A] actually say. Nor is there any evidence that that is what the skilled person would understand integer [A] to mean.

A switching arrangement for coupling a carrier wave to the modulator

83. In the context of the claim, a switching arrangement would be understood to mean a circuit containing switching (or commutating) transistors (such as Q1/Q2 and Q4/Q5 in Figure 2, Q8/Q9, Q10/Q11, Q12/Q13 and Q14/Q15 in Figure 3 and Q8/Q9, Q10/Q11, Q12/Q13 and Q14/Q15 in Figure 5B of the Patent).

A driver arrangement to couple an information signal to the modulator

84. In the context of the claim, a driver arrangement would be understood to mean a circuit which converts a differential voltage input to a differential current signal (such as Q3, Q6, R_{E1} and R_{E2}, and perhaps Q7, in Figure 2 and the circuitry coloured green by Prof Nauta in Figure 5 of the Patent.) As counsel for Nokia submitted, however, there is nothing in the specification, still less claim 1, to require the presence of all the circuitry coloured green by Prof Nauta in Figure 5. Indeed, if anything, the last sentence of [0040] (quoted in paragraph 67 above) suggests that, even in the context of this preferred embodiment, it is the current mirrors 7 that constitute the core of the driver arrangement.

At least one low-pass filter arrangement located between the pair of transistors

85. HTC contends that the claim covers the inherent filtering effect of a current mirror due to its parasitic capacitance at high frequencies. The effect of this construction is that the claim would read onto acknowledged prior art. It is well established that the skilled person would think it unlikely that the patentee intended the claim to cover acknowledged prior art. In any event, I consider that the skilled person would understand the words "low-pass filter arrangement located between" to refer to something additional to, not inherent in, the current mirror. Accordingly, I do not accept HTC's contention.

To filter the information signal to the modulator before the information signal is mixed with the carrier wave

86. HTC contends that these words are otiose and add nothing to the requirement that there be a low-pass filter arrangement between the transistors of the current mirror.

Again, it is well established that the skilled person would think it unlikely that the patentee intended wording such as this to be otiose. Nokia contends that it amounts to a functional requirement: the circuitry must be suitable for ensuring that the information signal is filtered before it is mixed with the carrier wave in the modulator. I accept Nokia's construction, which is a natural reading of the words bearing in mind that this is a product claim.

The prior art

Itakura

87. Itakura is entitled "Electronic circuit including means for reflecting signal current and feed forward means for compensating operational speed thereof". It was published on 21 November 1995. Although written in English, it gives the impression of having been translated from another language (presumably Japanese, since the inventor and assignee were both Japanese). The text is quite dense, and at first blush not very easy to follow. There are no less than 29 figures which illustrate the invention.

88. By way of overview, Itakura aims to improve the ability of a circuit containing a "current reflection element" (such as a current mirror) to pass high frequency signals, thereby improving the operational speed of the circuit (i.e. the ability to pass high frequency signals). It does this by means of the combination of a low-pass filter within the feedback circuit of the current mirror and a feed-forward signal path to allow high frequency signals to bypass the current mirror.

89. Itakura sets out the background to the invention at column 1 line 9 - column 2 line 23. This passage begins at column 1 lines 9-16 as follows:

> "The present invention relates to electronic circuits including signal current reflecting means such as current mirror circuits, reflection cascode circuits and the like, and more specifically to an electronic circuit including feedforward means for compensating operational speed of the signal current reflecting means. A multiplier is suggested as an example of the electronic circuit including the signal current reflecting means."

90. Itakura proceeds to explain the problem which it is seeking to address (column 1 lines 17 – 48). It describes a "conventional multiplier" as shown in Fig. 1 and explains that in practice a multiplier containing current mirrors as shown in Fig. 2 is "conventionally proposed". I have reproduced Fig. 2 of Itakura in paragraph 47 above and described the circuit in paragraph 48 above.

91. At high frequencies, current leaks across the parasitic capacitance which exists between the gates and sources of the current mirror transistors, reducing the gain across the current mirror. The consequence is that the current mirror, and the circuit of which it is part, cannot process high frequencies: at high frequency, the current leaks out through the parasitic capacitance, the gain across the current mirror drops and the operational speed of the circuit is decreased.

92. Itakura explains that the multiplier of Fig. 2, having four current mirrors, has an increased number of nodes (transistors), each with parasitic capacitances. The more

transistors there are, the greater the cumulative problem that is caused. At column 1 lines 60-65 Itakura particularly identifies PMOS FET and PNP bipolar transistors as having limited "element operation speed".

93. The invention is summarised at column 2 line 26 - column 3 line 24. At column 2 lines 31–58 Itakura states:

> "In order to achieve the above object, an electronic circuit according to the present invention and including signal current reflection means having an input portion and an output portion, comprises voltage-current conversion means for generating an output current in proportion with an input current; the signal current reflection means including the input portion having an input terminal for receiving the output current from the voltage-current conversion means and the output portion for outputting the current after reflection, and including <u>low frequency signal passing means</u> provided between a control electrode of a transistor constituting the input portion and a control electrode of a transistor constituting the output portion and for passing through a low frequency signal component occurring in the control electrodes of the transistors; <u>and feedforward means provided</u> between the input terminal of the input portion of the signal current reflection means and an output stage of the electronic circuit and for causing a high frequency signal component supplied to the signal current reflection means to flow into the output stage.
>
> <u>It is required that</u> the electronic circuit comprises <u>a low pass filter</u> for limiting a bandwidth of a control signal which is supplied to a <u>gate or base of at least a transistor through which an input current flows</u> in a current mirror circuit as the signal current reflection means, <u>and a feedforward signal path provided by a capacitance between an input terminal of the current mirror circuit and other terminal of the electronic circuit including the current mirror circuit</u>."

94. The underlining added above highlights the two key elements of the invention:

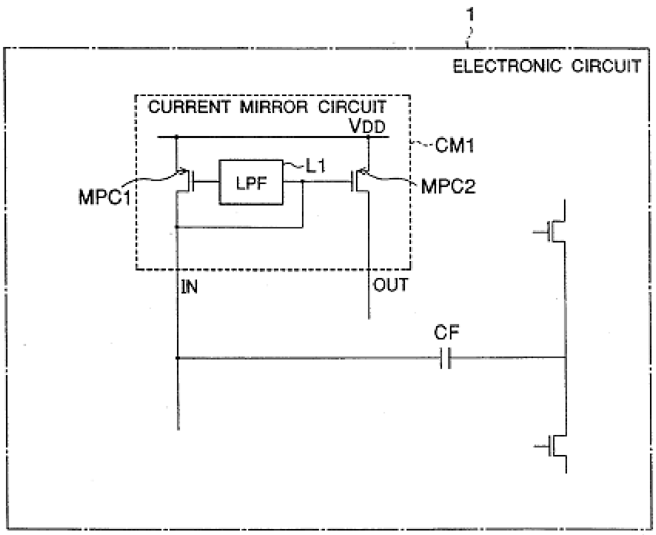
i) the circuit includes a low-pass filter which limits the bandwidth of the feedback signal which is supplied to the gate of the input transistor; and

ii) the circuit also includes a feed-forward signal path between the input terminal of the current mirror and the other terminal of the circuit.

95. Itakura explains how this circuitry works at column 2 line 59 – column 3 line 22:

> "As configured in the above construction, even though the current mirror circuit has a low input impedance with respect to the low frequency signal component because the low pass filter which is provided at the gate of the transistor in which the input current flows in the current mirror circuit supplies the control signal in which the high frequency signal component is limited, the electronic circuit including the current mirror has a high input impedance because the current mirror circuit operates as a constant current source with respect to the high frequency signal component.
>
> At this time, since the feedforward signal path is provided by a capacitance between an input of the current mirror circuit and other terminal of the electronic circuit, the signal is transmitted through the current mirror circuit in the low frequency, while the signal is transmitted through the feedforward signal path in the high frequency. Accordingly, since the signal of the high frequency is transmitted without passing through the current mirror circuit, it is impossible [*sic* – it is common ground that this should say "possible"] to improve the characteristics of the signal in the high frequency.
>
> As described above, since the input impedance in the current mirror circuit becomes larger in accordance with the frequency being higher, the high frequency signal component of the input current is fed forward to the output or the node near the output through the capacitance constituting the feedforward signal path. Since the signal in the high frequency can be transmitted by bypassing the current mirror circuit which is configured of a P-MOS FET, it is possible to prevent the deterioration of the performance caused by a gain in the current mirror circuit which is configured by the P-MOS FET."

96. Itakura describes a series of embodiments of the invention at column 5 line 6 – column 9 line 65 by reference to Figs. 3-29. Fig. 3 is not particularly easy to understand. It is easier to start with Fig. 4, which I reproduce below:

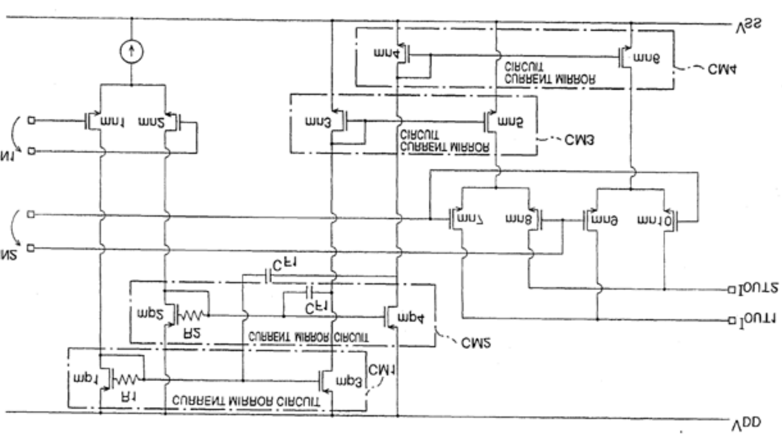


97. This is described by Itakura at column 5 line 32 – column 6 line 3. For low frequencies in the input signal, the low-pass filter in the feedback loop of the input transistor allows the signal to reach the gate of the input transistor and hence to affect

the gate-source voltage and so control that gate, allowing the input transistor to respond to the current variation in the input signal (and for that current to be mirrored in the output of the current mirror). The input transistor therefore has a low input impedance with respect to low frequencies in the input signal. Furthermore, the capacitor in the feed-forward circuit has a high impedance to low frequency signals and so little low frequency signal flows through the feed-forward circuit. The low frequency signal instead passes across the current mirror, and because the cut-off frequency of the low-pass filter is set to be below that at which the parasitic gate-source capacitances of the transistors become a problem, the gain across the current mirror is constant.

98. For high frequencies in the input signal, however, the low-pass filter in the feedback loop prevents the signal reaching the gate of the input transistor and hence the gate of the input transistor being controlled. Therefore the input transistor acts as a constant current source, and hence the impedance of the input transistor is high for high frequencies. As Prof Nauta put it in his second report, this high impedance acts as a "roadblock". The effect of this is to divert the high frequencies in the input signal through the feed-forward signal pathway (which allows high frequencies to pass). Because the high frequency component of the signal is bypassing the current mirror, it is not subject to the parasitic gate-source capacitances of the transistors which would otherwise cause a reduction in gain across the current mirror at high frequencies (affecting the performance of the current mirror at high frequencies and reducing the

FIG. 28



99. ... recombined with the ... h and low frequency ... cuit.

100. ... in various different ... g. 6 at column 6 lines ... RC filter or a resistor ... en transistor.

101. ... ltiplier shown in FIG.

102. If this is compared with Fig. 2, it can be seen that this is a similar Gilbert cell with current mirrors. The difference is that the circuit now includes low-pass filters formed by resistors R1 and R2 and the inherent capacitance and feed-forward paths via capacitors C_{F1} and C_{F2} in current mirrors CM1 and CM2. After the signal has been recombined, it is then multiplied in transistors mn7 to mn10 with the signal V_{IN2}.

103. As Itakura explains at column 9 lines 36-40, the configuration of Fig. 28 makes it possible to prevent the parasitic capacitance of the input transistors of the current mirrors from affecting the high frequency characteristics of the circuit.

Tan

104. Tan is entitled "Voltage-to-current converter". It was published on 13 November 1997. This time the English is better (despite the fact the inventors and assignee were all Swedish).

105. Tan is concerned with voltage-to-current converters for use in analogue/digital interfaces. It explains at page 1 lines 8-14 that a typical analogue/digital interface includes both an anti-aliasing filter and an analogue-to-digital converter A/D (or ADC), as shown in Fig. 1 which I reproduce below:

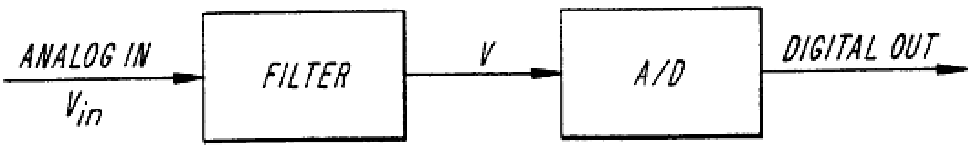


Fig. 1

106. The problem addressed by Tan is set out at page 1 line 15 – page 2 line 10. It concerns what Tan calls the "conventional 'voltage-mode' method". This refers to circuits in which information is represented in the form of voltage variations. Tan explains that there are two drawbacks with analogue/digital interfaces using the voltage mode. The first is that voltage-mode circuits require linear capacitors (capacitors that respond linearly with respect to the voltage input across a wide range), which are expensive to make. The second is that, for "mixed-voltage applications", in which part of the circuit is operating at high voltages and part at low voltages, it is necessary to limit the swing of the high voltage part of the circuit to avoid damaging the low voltage part. This in turn reduces the dynamic range of the high voltage circuit. Tan gives a linecard circuit as an example of an analogue/digital interface using mixed voltages. Linecard circuits are interfaces, for example connected to telephone lines.

107. Tan explains that, to overcome these drawbacks, the current mode can be used instead. When using the current mode, the input voltage is first fed into a voltage-to-current converter, and then passed to the anti-aliasing filter and then the ADC. This is shown in Fig 2:

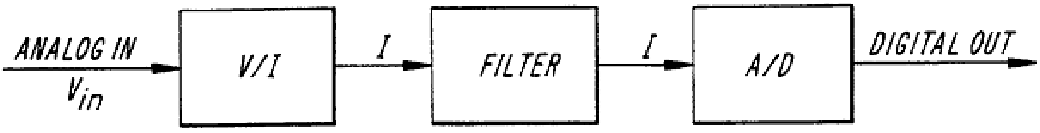


Fig. 2

108. Tan explains that, since the interface now processes currents rather than voltages, linear capacitors are no longer necessary and large input voltages can be used. This requires an extra component and it would be desirable for the analogue/digital interface to include both a voltage-to-current conversion capability and a filtering capability in a component that can easily be fabricated.

109. Accordingly, Tan discloses a voltage-to-current converter which incorporates an anti-aliasing low-pass filter, as shown in Fig 3:

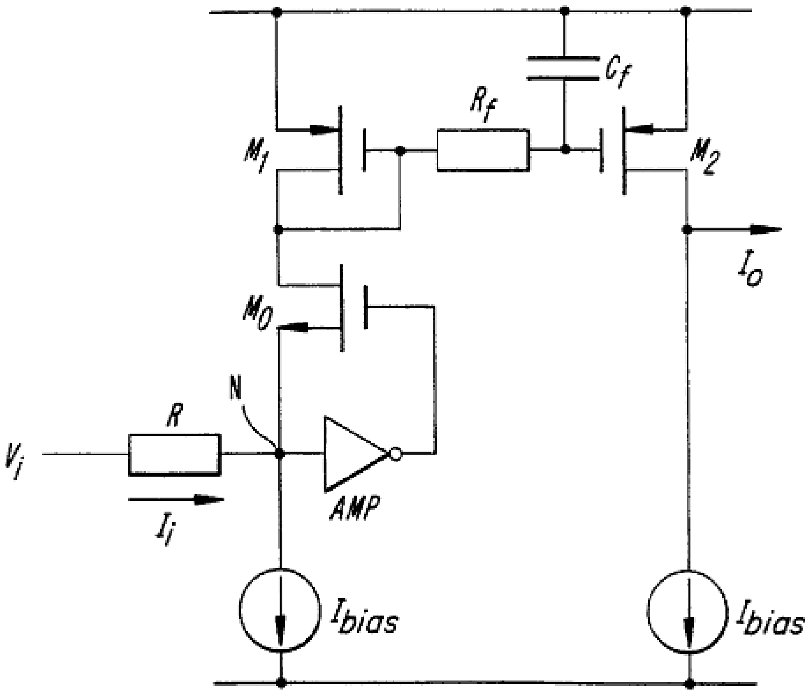


Fig. 3

110. Tan explains the operation of this circuit at page 3 line 21 - page 5 line 2. The voltage-mode signal V_i is converted to a current-mode signal I_i of magnitude $V_i/(R + R_i)$ where R_i is the impedance at node N. R_i is kept low by using a negative feedback loop including the inverting amplifier AMP. The effect is that large voltage changes in the input signal V_i are converted into a current-mode signal with only small voltage changes at node N. The current-mode signal is then mirrored in the current mirror, again with only small voltage variations at the gates of the current mirror. Tan also explains that the current mirror has a dominant pole introduced into it (i.e. a filter with a cut-off frequency lower than other parts of the circuit) and that enables a single-pole low-pass filtering system to be realized in the V/I converter. Tan says at page 4 lines

14-15 that "the V/I configuration of FIG 3 is thus desirable for mixed-voltage applications such as linecard circuits."

111. At page 5 lines 5-14 Tan says that:

> "Unlike in a traditional voltage-mode filter, the voltage change at the gates of M_1 and M_2 in the circuit of FIG.3 are small and the demand on the linearity of passive components is significantly reduced."

This has benefits in terms of the components that can be used, the chip area required, the fabrication techniques that can be used and the power consumption that is needed.

112. Thus Tan discloses a way to integrate a V/I converter and an anti-aliasing filter for use before an ADC (such as in a linecard interface) in a way that allows fabrication on a single chip. The key idea is to compress the input voltage signal by converting the signal into the current domain and then into small voltage variations in the circuit.

Novelty

113. As was explained by the House of Lords in *Synthon BV v SmithKline Beecham plc* [2005] UKHL 59, [2006] RPC 10, in order for an item of prior art to deprive a patent claim of novelty, two requirements must be satisfied. First, the prior art must disclose subject matter which, if performed, would necessarily infringe that claim. Secondly, the prior art must disclose that subject matter sufficiently to enable the skilled addressee to perform it. The dispute in the present case is as to the first requirement.

Novelty of claim 1 over Itakura

114. HTC contends that claim 1 lacks novelty over Itakura, and in particular Fig. 2 and Figs. 28 and 29. Since there is no material difference between Figs. 28 and 29 for present purposes, I have focussed on Fig. 28. Nokia disputes that Itakura discloses a modulator at all or that it discloses integer E.

115. *Modulator*. I have construed the word "modulator" above. On its face, Itakura does not disclose a modulator. Rather, it discloses a multiplier in Fig. 28. HTC's case is that the skilled reader would nevertheless appreciate that the multiplier disclosed by Itakura would function as a modulator under appropriate conditions, in particular with a very low voltage signal input. Prof Nauta accepted, and I find, that it would be obvious to the skilled person that Itakura's multiplier could be used as a modulator under appropriate conditions, and in particular with appropriate additional circuitry. In my judgment, however, Itakura does not disclose a modulator. Nowhere does Itakura suggest the use of his multiplier as a modulator. Nor does Itakura suggest the use of his multiplier under conditions in which it would function as a modulator (i.e. very low voltage conditions). Nor does Itakura suggest the use of his multiplier with additional circuitry which would make it function as a modulator.

116. *Integer E*. I have construed integer E above. The effect of my construction is that the inherent capacitance of the current mirrors of Fig. 2 of Itakura do not fulfil the requirement for a low-pass filter arrangement, contrary to HTC's contention.

117. It is common ground that Figs. 28 and 29 of Itakura do disclose low-pass filters located between pairs of transistors in current mirrors. The remaining issue is whether these circuits fulfil the requirement "to filter the information signal to the modulator before the information signal is mixed with the carrier wave".

118. As Prof Nauta explained and Mr Crawford accepted, what Itakura does is to divide the input signal into two parts – the low frequency part goes through the current mirror and the high frequency part goes through the high frequency bypass. The low-pass filter in the feedback loop of the current mirror does not filter the information signal in the sense of filtering out unwanted components. Instead, it causes a roadblock to divert the high frequency components down the bypass. Furthermore, the two parts of the input signal are recombined prior to the mixing of the input signal with the carrier wave. It is clear that Itakura's intention is that the recombined signal will be exactly the same as the original signal. Thus there is no filtering of the information signal before it is mixed with the carrier wave. Accordingly, this feature of claim 1 is not disclosed.

Novelty of claim 6 over Itakura

119. The dispute with regard to claim 6 is as to whether, assuming Itakura discloses a modulator at all, it discloses a direct conversion modulator. Again, Prof Nauta accepted, and I find, that it would be obvious that it could be used as a direct conversion modulator under certain limited conditions. Again, however, it does not disclose a direct conversion modulator.

<u>Obviousness</u>

The law

120. The structured approach to the assessment of allegations of obviousness first articulated by the Court of Appeal in *Windsurfing International Inc v Tabur Marine (Great Britain) Ltd* [1985] RPC 59 was re-stated by Jacob LJ in *Pozzoli v BDMO SA* [2007] EWCA Civ 588, [2007] FSR 37 at [23] as follows:

> "(1)(a) Identify the notional 'person skilled in the art';
>
> (b) Identify the relevant common general knowledge of that person;
>
> (2) Identify the inventive concept of the claim in question or if that cannot readily be done, construe it;
>
> (3) Identify what, if any, differences exist between the matter cited as forming part of the 'state of the art' and the inventive concept of the claim or the claim as construed;
>
> (4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?"

121. The skilled person is deemed to read the prior art properly, and in that sense with interest, but without assuming that it will provide him with any assistance in solving the problem which confronts him: see *Terrell on the Law of Patents* (17th ed) §§12-27 to 12-30.

Obviousness of claim 1

122. I have already identified the person skilled in the art and the common general knowledge and construed the claim. In the light of my conclusions on novelty, there are two differences between Itakura and claim 1. First, Itakura does not disclose a modulator. Secondly, Itakura does not disclose the last feature of the claim. I have already held, however, that it would be obvious to the skilled person that the multiplier circuit shown in Fig. 28 of Itakura could be used as a modulator under appropriate conditions. The remaining question is whether it would be obvious in the light of Itakura to design a Gilbert cell modulator with current mirrors in the driver arrangement and low-pass filters between the transistors of the current mirrors to filter the information signal before it is mixed with the carrier wave. In the case of Tan, it is common ground that this does not disclose a modulator at all, or even a multiplier.

123. In his written closing submissions, counsel for HTC expressly advanced precisely the same argument of obviousness over both Itakura and Tan. Furthermore, when I asked about this during his oral submissions, he said that, if forced to choose between them, he would choose Tan. In my view, this approach betrays the weakness of HTC's case, because Itakura and Tan are different pieces of prior art directed to different problems and teaching the skilled person different things. Furthermore, of the two, Tan is on its face less close prior art than Itakura.

124. As noted above, the argument starts with a skilled person who is seeking to design or improve a direct conversion modulator in a mobile phone. Counsel for HTC submitted that such a person would have been faced with the problem that the move from superheterodyne to direct conversion, and the consequent removal of the SAW filter, placed pressure on the performance on the rest of the transmit chain, and in particular its noise. In my judgment, this was not established on the evidence. I consider that the evidence does establish, however, that the skilled person would have been concerned to ensure adequate noise performance among a number of other characteristics.

125. The next step in the argument is to posit that the skilled person's starting point is a Gilbert cell with current mirrors in the driver arrangement such as that depicted in Fig. 2 of Itakura. Since I have found that such cells were common general knowledge, I accept that the skilled person could well start with that design.

126. Against this background, the skilled person is presented with either Itakura or Tan. As I have already noted, for the purposes of HTC's argument, it does not matter which. Counsel for HTC submitted that, in those circumstances, what the skilled person would immediately see in the prior art document is the idea of placing a low-pass filter inside a current mirror. Since this was not common general knowledge, the skilled person would be interested in it. He would immediately appreciate the utility of such a filter and would readily see that he could use it in the current mirrors of his Gilbert cell modulator and in a signal path where he had a real need for filtering. Thus he would arrive at a circuit within claim 1.

127. I do not accept this argument for a number of reasons. First, although counsel for HTC was careful not to emphasise this aspect of the argument, it depends on the proposition that the problem which the skilled person would have been concentrating on was reduction of noise in the information signal. But this was not established on the evidence.

128. Secondly, Prof Nauta's clear evidence was that this would not have been obvious, while Mr Crawford's evidence that it was obvious was deeply unconvincing. I do not propose to go into this in detail, but I will briefly exemplify the point by reference to Itakura. Mr Crawford illustrated in Figures 2 and 3 of his sixth report how he considered that the skilled person would have modified Fig. 2 of Itakura so as to fall within claim 1. As Prof Nauta explained and Mr Crawford was forced to accept, however, Mr Crawford's illustrations did not in fact implement the teaching of Itakura. Even ignoring the fact that they did not include Itakura's feed-forward path, Mr Crawford had not placed the low-pass filter within the feedback loop of the input transistor. Mr Crawford also illustrated in Figure 4 of the same report a modification of Fig. 29 of Itakura with the feed-forward feature removed. As he readily accepted, however, the skilled person would not have done this. Thus what Mr Crawford was forced back to, as was counsel for HTC in his cross-examination of Prof Nauta, was the assertion that it would have been obvious to the skilled person to take just the idea of putting a low-pass filter in the current mirror from Itakura. There were similar flaws in Mr Crawford's approach to Tan.

129. Thirdly, and most fundamentally, in my view HTC's argument is a classic application of hindsight.

130. If one takes Itakura, the skilled person reading Itakura properly in October 1998 would see that Itakura was about improving the ability of a circuit containing a current mirror to pass high frequency signals, thereby improving the operational speed of the circuit. The problem arises because at high frequencies the parasitic capacitance of the transistors causes current to leak through the transistors to the supply line, and that means the gain of the current mirror drops. High frequency components of the signal are lost rather than being passed by the circuit.

131. The skilled person would also see that Itakura solves this problem by means of a low-pass filter inside the feedback loop of the input transistor of the current mirror and a feed-forward path. The skilled person would understand that this solution works in the manner I have explained above. Accordingly, the skilled person would appreciate that the two elements of the solution – the low-pass filter inside the feedback loop and the feed-forward path – do not operate independently of each other, but in conjunction. He would also appreciate that it was important for Itakura's purposes that the low-pass filter was inside the feedback loop of the input transistor. He would also appreciate that the net result was a circuit which processed the signal in precisely the same way as before, but with a higher speed of operation. Finally, he would appreciate, if he thought about it, that Itakura was not dealing with filtering noise from the information signal of a modulator.

132. In order to arrive at claim 1, the skilled person needs to extract from Itakura part of Itakura's solution to his problem and then apply it in a different context to solve a different problem. I am wholly unpersuaded that that would have been an obvious step to take without the benefit of hindsight.

133. Turning to Tan, the skilled person reading Tan properly in October 1998 would see that Tan was about anti-aliasing filters upstream of ADCs. The problem is that, in mixed voltage circuits, using voltage mode means that linear capacitors are needed, but they are expensive to make. Furthermore, the voltage swing in the high voltage part needs to be reduced to avoid damaging the low voltage part, but this reduces the dynamic range. Using the current mode in these circuits avoids the need for linear capacitors and allows the use of larger voltage swings, but it requires the use of a voltage-to-current converter as well as the anti-aliasing filter. Thus what Tan is trying to do is integrate a voltage-to-current converter with the anti-aliasing filter in a way which can be easily fabricated using CMOS fabrication techniques. The skilled person would understand that the circuit disclosed in Tan works in the way that I have described above.

134. The skilled person would appreciate that Tan was nothing to do with modulators, transmitters or mobile phones. Accordingly, the skilled person would not regard it as relevant to his task.

135. In any event, in order to arrive at claim 1, the skilled person again needs to extract from Tan part of Tan's solution to his problem and then apply it in a different context to solve a different problem. Again, I am wholly unpersuaded that that would have been an obvious step to take without the benefit of hindsight.

Obviousness of claims 6 and 7

136. If claim 1 was obvious over either Itakura or Tan, then in my judgment claims 6 and 7 would be equally obvious. As it is, this question does not arise.

Infringement

137. Nokia alleges infringement of the Patent by certain HTC phones. HTC sought a declaration of non-infringement in relation to certain other phones, and in due course Nokia conceded that these did not infringe. Turning to the phones which are alleged to infringe, the parties identified a number of representative devices. These contain chips manufactured by Broadcom and Qualcomm which are alleged to implement the features of the claims. The representative devices and the corresponding chips are as follows:

Devices	Chips
One SV (non-LTE)	Qualcomm WTR1605
One, One SV (LTE)	Qualcomm WTR1605L
Wildfire S	Broadcom BCM4329
One SV (LTE),	Broadcom BCM4334

One SV (non-LTE)	

138. In order to prove infringement, Nokia obtained disclosure of documents from Broadcom and Qualcomm pursuant to a US court order. The documents were disclosed upon stringent terms as to confidentiality. There is no dispute that the documents contain technical confidential information which Broadcom and Qualcomm are entitled to protect. HTC's written closing submissions helpfully described the circuits at a level of generality which did not involve disclosing the precise details of any of the circuits. When this judgment was circulated in draft, however, Broadcom and Qualcomm objected to public disclosure even of that information. Accordingly, I set it out in Confidential Annex 2. This has the regrettable consequence that some of what follows will be obscure to those who do not have access to that annex.

139. HTC's principal non-infringement argument is that none of the alleged infringements uses a Gilbert cell. Its secondary argument is that neither the low-pass filter nor the current mirror is in the modulator in any of the circuits.

140. As counsel for Nokia pointed out, HTC's primary argument was not foreshadowed in Mr Crawford's evidence or in HTC's skeleton argument, nor was it put squarely to Prof Nauta in cross-examination. Not only that, but in addition the argument involves a complete *volte-face* from HTC's opening position. In paragraph 62 of its skeleton argument HTC stated in relation to the construction of claim 1 that "[t]he driver arrangement is required to be part of the modulator, but not required to be part of the Gilbert cell itself". By contrast, in paragraph 94 of its closing submissions, HTC stated in relation to the construction of claim 1 that "a Gilbert cell necessarily contains both switching and driver arrangements as an integral part of it". On this basis, HTC contended in paragraph 21 of the annex to its closing submissions that the alleged infringements did not use Gilbert cells because "whilst we accept that the equivalent of the whole of Figure 5B is present, there is absolutely no equivalent of Figure 5A; half the 'Gilbert Cell' is simply missing". In other words, the argument is that, for the purposes of the claim, the Gilbert cell must include a driver arrangement, and moreover must include a driver arrangement equivalent to that shown in Figure 5A of the Patent.

141. I acknowledge that HTC's second thoughts may be better than its first ones. Having considered the closing argument on its merits, however, I do not accept it. I have set out my construction of claim 1 above. As I have construed it, claim 1 requires a modulator which includes both a switching arrangement and a driver arrangement. It does not require that the driver arrangement be part of the Gilbert cell. Still less does it require that the driver arrangement include all the circuitry shown in Figure 5A.

142. During the course of his oral closing submissions, counsel for HTC suggested that a Gilbert cell required a minimum of six transistors as shown in Figure 10.9 of Gray & Meyer, and that the circuits alleged to infringe did not fulfil this requirement since they only included four transistors. I do not accept this. As I have explained, it is clear from Gray & Meyer that it is possible to construct a Gilbert cell, including a Gilbert cell for use as a modulator, with only four transistors and appropriate surrounding circuitry. Prof Nauta's evidence is consistent with this, and there is no evidence to the contrary. In any event, as counsel for Nokia submitted, if notionally one puts a box

around Q2, Q3 and Q4 for one channel and the corresponding transistors for the complementary channel, there are six transistors in the arrangement shown in Confidential Annex 2.

143. Counsel for HTC also suggested that the circuits alleged to infringe could not be Gilbert cells because there was no voltage-to-current conversion. I do not accept this. As counsel for Nokia submitted, that is what transistor Q2 does. The non-linearity of Q2 is compensated for by the non-linearity of Q1.

144. In those circumstances, I find that each of the circuits is a modulator which uses a Gilbert cell. Furthermore, the modulator comprises a driver arrangement, namely Q1, Q2 and LPF (together, if need be, with the corresponding components of the complementary channel).

145. Turning to HTC's secondary argument, HTC contends that the circuits merely contain a sequence of current mirror, low-pass filter and switching arrangement as shown in Figure 3 of the Patent, each performing their ordinary functions in "sausage machine" fashion. Accordingly, HTC says that neither the current mirrors nor the low-pass filters are in the modulator.

146. I do not accept this argument either. In reality, it is essentially the same argument as HTC's primary argument, albeit presented in a different way. I find that the low-pass filter LPF is in the current mirror comprising Q1 and Q2 which forms part of the driver arrangement which forms part of the modulator.

147. Accordingly, I conclude that each of the representative devices falls within claim 1 of the Patent. That being so, I do not understand it to be disputed that claims 6 and 7 are also infringed.

<u>HTC's licence defence</u>

148. HTC contends that, even if the Patent is valid and the representative devices fall within the claims, in the case of those devices which incorporate Qualcomm chips, it has a defence of licence. This is said to arise because HTC purchased the chips from Qualcomm and there is an agreement between Nokia and Qualcomm dated 22 July 2008 which contains a covenant by Nokia not to sue Qualcomm for infringement of various patents, including the Patent, in certain circumstances ("the Agreement"). The precise terms of the Agreement are regarded by both Nokia and Qualcomm as highly confidential. Accordingly, I set out the relevant terms in Confidential Annex 3.

149. The Agreement is governed by Delaware law. There is no dispute between the parties as to the principles of Delaware law with regard to the interpretation of contracts, which are little different to those of English law. HTC contends, however, that this brings into play a doctrine of US Federal patent law known as the first sale or exhaustion doctrine. This provides that, in certain circumstances, the sale of a patented article exhausts the patentee's rights under the patent. The parties are sharply divided as to the circumstances in which this doctrine applies. It is to this issue that the evidence of Prof Schultz and Prof Holbrook was directed.

150. It is important to note before proceeding further that it is common ground that HTC purchased the chips in question from Qualcomm in Taiwan, where there is no

equivalent to the Patent in force. It is also common ground that the Agreement has two main provisions in it that are relevant. As explained in Confidential Annex 3, HTC was given notice by Qualcomm (and Nokia) of one of these provisions, but not the other.

151. *English law*. As counsel for HTC accepted, it is necessary to begin by considering the relevant English law. Liability for infringement of a European Patent (UK) is governed by section 60 of the Patents Act 1977. For present purposes, the relevant provision is section 60(1), which, so far as relevant, provides that:

> "… a person infringes a patent for an invention if, but only if, while the patent is in force, he does any of the following things in the United Kingdom in relation to the invention without the consent of the proprietor of the patent …"

152. HTC contends that, by virtue of the Agreement and US Federal patent law, Nokia has consented (or, perhaps more accurately, is to be deemed to have consented) to HTC's acts which are alleged to infringe the Patent so far as they involve the Qualcomm chips. Nokia contends that, applying well established principles of English law and construing the Agreement in accordance with the relevant principles of Delaware contract law, it has not consented to such acts.

153. It is worth noting before proceeding further than HTC does not contend that Nokia's rights under the Patent have been exhausted by virtue of Article 36 of the Treaty on the Functioning of the European Union. This is because the chips were not placed on the market in the European Economic Area by Nokia or with its consent. Nor does HTC contend that English law contains any doctrine of international exhaustion of patent rights.

154. Where a patentee sells a patented product, then, absent an agreement to the contrary, the purchaser has the right to dispose of the product. If the sale is abroad, the purchaser's rights extend to importing the product into the UK and selling it here. This was established by the well-known case of *Betts v Willmott* (1870-71) LR 6 Ch App 239. In that case Betts owned both English and French patents for the same invention. He claimed that his English patent had been infringed by Willmott. It appeared that the infringing articles had been manufactured by a factory owned by Betts in France (or, at least, Betts could not prove that this was not the case). Betts argued that, if he sold a patented article in France, it was for the French market and that did not justify a person buying that article in France and importing it into England. Lord Hatherley LC held that in these circumstances the use of the invention in England had been authorised by Betts. As he said in a much-cited passage at 245:

> "But where a man carries on the two manufactories himself, and himself disposes of the article abroad, unless it can be shewn, not that there is some clear injunction to his agents, but that there is some clear communication to the party to whom the article is sold, I apprehend that, inasmuch as he has the right of vending the goods in *France* or *Belgium* or *England* , or in any other quarter of the globe, he transfers with the goods necessarily the license to use them wherever the purchaser pleases. When a man has purchased an article he expects to

> have the control of it, and there must be some clear and explicit agreement to the contrary to justify the vendor in saying that he has not given the purchaser his license to sell the article, or to use it wherever he pleases as against himself."

155. As Lord Hoffmann pointed out in *United Wire Ltd* v *Screen Repair Services (Scotland) Ltd* [2001] RPC 24 at [68]-[69], this reasoning amounts to saying that the patentee has impliedly licensed the acts complained of, but an alternative explanation adopted by some other legal systems is that of exhaustion of rights. As Lord Hoffman noted:

> "The difference in the two theories is that an implied licence may be excluded by express contrary agreement or made subject to conditions while the exhaustion doctrine leaves no patent rights to be enforced."

156. As a result of this distinction, the patentee may exclude such an implied licence by expressly limiting the rights granted to the purchaser. To be effective, however, this limitation must be notified to subsequent purchasers of the goods. As Jacob J stated in *Roussel Uclaf SA v Hockley International Ltd* [1996] RPC 441 at 443:

> "It is the law that where the patentee supplies his product and at the time of the supply informs the person supplied (normally via the contract) that there are limitations as to what may be done with the product supplied then, provided those terms are brought home first to the person originally supplied and, second, to subsequent dealers in the product, no licence to carry out or do any act outside the terms of the licence runs with the goods. If no limited licence is imposed on them at the time of the first supply no amount of notice thereafter either to the original supplyee (if that is the appropriate word) or persons who derive title from him can turn the general licence into a limited licence. "

157. Where a patented product has been sold abroad by a licensee of the patentee, rather than the patentee himself, the position is different. In *Société Anonyme des Manufactures de Glaces v Tilghman's Patent Sand Blast Company* (1883) 25 Ch D 1 the defendant owned patents in England and Belgium. The defendant granted the plaintiff a licence to manufacture the patented product in Belgium. The plaintiff sold products made in Belgium in England. The plaintiff brought a claim for threats arising out of circulars issued by the defendant. The Court of Appeal held that a licence under a Belgian patent was not the same thing as a licence under the English patent and thus did not prevent the patentee from exercising its right to prevent import and sale in England. Cotton LJ distinguished *Betts v Willmott* at 9 as follows:

> "In my opinion the license to use a patented invention under a foreign patent stands in a very different position from the sale of an article manufactured under either a foreign or an English patent. When an article is sold without any restriction on the buyer, whether it is manufactured under one or the other patent, that, in my opinion, as against the vendor gives the purchaser

> an absolute right to deal with that which he so buys in any way he thinks fit, and of course that includes selling in any country where there is a patent in the possession of and owned by the vendor. Here, as is pointed out, it is simply a license to manufacture. "

158. *Tilghman's* case has been applied in a number of subsequent cases. In *Beecham Group Ltd v International Products Ltd* [1968] FSR 162 Beecham sought an interim injunction to restrain the sale in Kenya of hetacillin which the defendants had purchased from Bristol-Meyers in the USA. Bristol-Myers was licensed by Beecham under its US patent, but not under its Kenyan patent. Rudd J sitting in the High Court of Kenya held at 170 that:

> "In the case of a sale by a licensee the matter must depend on the extent of the authority conferred on the licensee by the licensor under the licence or other agreements between them. In this case the American or Panamanian patents are not the same patents as the patents registered in Kenya, and it follows that a release or discharge from the monopoly of United States or Panamanian patents does not necessarily imply a release from the Kenya patent. Whether there is such a release from the Kenya patent must depend on the contract. The mere ownership of the patented articles does not imply a discharge from foreign patents."

159. The same approach was adopted by the Supreme Court of Hong Kong in *Beecham Group Ltd v Shewan Tomes (Traders) Ltd* [1968] RPC 268 and by Graham J in *Minnesota Mining & Manufacturing Co v Geerpres Europe Ltd* [1973] FSR 133. In the latter case, a licensee in the US had sold the products to a party which had resold them to the defendant which imported the goods into the UK. The licence was restricted to the US patent and did not cover the English equivalent. Graham J held at 139-140 that:

> "The 1971 agreement, exhibit PJT. 3, now governs the matter and this, it is stated, must be construed according to the law of New York State. As such it is the subject of the evidence of Mr. Schoemer, a New York lawyer. He makes it clear that no right by that agreement is given to Union Carbide to license anyone under the plaintiffs' English patent here in question. This being the position, Union Carbide cannot pass on to Rhodes any rights which they themselves have not got, and Rhodes equally cannot pass on any such rights to the defendants. The latter, therefore, though they could presumably use or sell the goods in question in the U.S.A., cannot import them into this country without running foul of the plaintiffs' English letters patent. As I see it, all that is involved here is straightforward enforcement of rights under United Kingdom letters patent …."

160. Likewise, in *Wellcome Foundation Ltd v Discpharm Ltd* [1993] FSR 433 His Honour Judge Ford took the territorial limitations of a licence granted to a wholly-owned

foreign subsidiary of the plaintiff patentee into account in concluding that there was no implied licence to import the patented product into the UK.

161. Finally, I note that in the recent copyright case of *Football Association Premier League Ltd v QC Leisure (No 2)* [2008] EWHC 1411 (Ch), [2008] FSR 32 at [171]-[173] Kitchin J (as he then was) applied *3M v Geerpres* and distinguished *Betts v Willmott*.

162. On their face, the post-*Tilghman* cases are authority for the proposition that a purchaser from a licensee can only acquire such rights as the licensee has. More specifically, if the licensee is licensed under a foreign patent, but not under the UK patent, then the purchaser acquires no licence under the UK patent. Counsel for HTC challenged the correctness of this proposition, however. He submitted that it was not supported by *Tilghman* and unsound in principle. He argued that, whether goods were purchased from the patentee or a licensee, the question was the same: did the purchaser have notice of any restrictions on the ambit on his licence to deal in those goods?

163. So far as *Tilghman* is concerned, counsel for HTC pointed out that it was not a case about a purchase from a licensee. Rather, it was a case where the licensee was itself trying to sell the patented articles in England. Since it was licensed under the Belgian patent, it had notice of the territorial restriction of the licence. I acknowledge that the decision could be justified on that basis, but as I read the judgments, that was not the Court of Appeal's reasoning. Rather, the court considered that there was a fundamental distinction between a sale of a product and a licence under a patent. Where a product was sold, the purchaser acquired all rights that were not expressly reserved. Where a patent was licensed, the licensee acquired only those rights which were expressly or necessarily granted. As I see it, I am bound by that reasoning.

164. As to principle, counsel for HTC argued that there was no good reason why the position should be different when goods are sold by an express licensee rather than by an implied licensee, and in particular no good reason why sales by an implied licensee should receive more favourable treatment. Put like that, I can see the force of the argument. In my judgment, however, the argument involves a sleight of hand. In the *Betts v Willmott* scenario, the licence is implied as a result of the outright sale of the goods by the patentee without restrictions. In the absence of restrictions, as I have said, the purchaser acquires all rights. Thus he acquires a licence which is territorially unlimited. By contrast, in the *Tilghman* line of cases, the licence is territorially limited.

165. I agree that it is a little odd that, in the *Betts v Willmott* scenario, the patentee can lose his right to enforce his patent as a result of a failure by a subsequent vendor to give notice of applicable restrictions to a subsequent purchaser. This is particularly so given that the vendor may be a person with whom the patentee has no contract or even knowledge of his existence. How then does an implied licence arise? But this does not necessarily support the conclusion that a sale by an express licensee should stand in the same position. An alternative analysis is that a sale exhausts the patentee's rights and that this cannot be trumped by contractual restrictions. In this regard, I would point out that section 60(1) was intended to implement Article 25 of the Community Patent Convention and must be construed in that light: see generally *Grimme Landmaschinefabrik GmbH v Scott* [2010] EWCA Civ 1110, [2011] FSR 7 at [77]-

[85] and [95]-[98]. Article 28 CPC dealt with exhaustion of Community patents and Article 76 CPC dealt with exhaustion of national patents. Neither provided on their face for exhaustion to be excluded by contract. As matters stand, however, I am bound by *Betts v Willmott*.

166. Counsel for HTC also argued that the principle *nemo dat quod non habet* was a principle of property law and therefore was inapplicable to licences, which are not property rights. Furthermore, he argued that a licensor could grant a licensee a licence which authorised the licensee to grant sub-licences broader than the head licence. In my judgment, neither of these points takes him any further. As to the first, the key point remains that a licence only confers such rights on the licensee as, on the true construction of the relevant document, the parties agreed. If the licensee has no right to sell in the UK, then a purchaser from the licensee cannot be in a better position. As to the second point, I accept that in principle this is possible. But if that occurred, it would be because that was what the licensor had agreed: see *VLM Holdings Ltd v Ravensworth Digital Services Ltd* [2013] EWHC 228 (Ch).

167. Counsel for HTC sought to gain support from the following statements of principle by Laddie J in *Zino Davidoff SA v A & G Imports Ltd* [2000] Ch 127 at [39]:

> "(6) … the proprietor of a registered trade mark cannot use it to prevent authorised external goods from entering the EEA if he has agreed, expressly or otherwise, to such entry or he has, directly or otherwise, placed the goods in the hands of a third party under conditions which give the third party a right to distribute and onward sell them without restriction.
>
> (7) In deciding whether the third party has a right to distribute and onward sell them without restriction regard must be had to all the relevant circumstances including the nature of the goods, the circumstances under which they were put on the market, the terms of any contracts for sale and the provisions of any applicable law.
>
> (8) In particular, the rights of the third party can be determined by the law of the contract of supply to that customer or the law of the non-EEA country in which the sale to the third party takes place. Where that law includes a rebuttable presumption that, in the absence of full and explicit restrictions being imposed on purchasers at the time of purchase, the proprietor is treated as consenting to the goods being imported into and sold in the EEA, courts within the EEA are free to recognise the effect of that law and to allow importation of the authorised external goods accordingly."

168. I do not consider that these observations assist HTC, for a number of reasons. First, that was a trade mark case. As Laddie J explicitly warned at [40], the position with regard to other intellectual property rights may be different. Secondly, even in the field of trade marks, Laddie J's analysis is no longer authoritative following the ruling of the Court of Justice of the European Union on the questions he referred to it in Joined Cases C-414/99, C-415/999 and C-416/99 [2001] ECR I-8691. Thirdly, no

doubt because it was a trade mark case, none of the *Tilghman* line of cases was considered in the judgment or even cited in argument. Fourthly, as a result, Laddie J simply did not address the distinction between goods purchased from the patentee and goods purchased from a licensee with which I am concerned. Fifthly, Laddie J focussed upon the law of the country where the goods were sold to the third party. In the present case, that is Taiwan; yet HTC does not rely upon Taiwanese law as part of its licence defence.

169. For the reasons given above, I conclude that, as a matter of English law, HTC cannot have acquired greater rights on purchasing the chips from Qualcomm than Qualcomm was granted by Nokia under the Agreement. Thus it is immaterial that HTC was not notified of one of the provisions in the Agreement.

170. Counsel for HTC raised a separate argument concerning the provision of the Agreement which it is accepted that HTC had notice of. The detail of the argument is explained in Confidential Annex 3. In broad terms, however, the argument concerns the construction of section 60(1). Counsel for HTC submitted that, if the vendor of a product covered by a patent was licensed by the patentee to sell the product in the UK, then the purchaser did not require a separate licence, and that this was so even if that was what the vendor's licence expressly provided and the purchaser had notice of that restriction. This submission was not based on implied licence or exhaustion of rights, but purely on section 60(1). I do not accept it. By virtue of section 60(1), the purchaser will require the patentee's consent to keep the product, whether for disposal or otherwise. There is nothing in section 60(1) which precludes the purchaser requiring a separate licence. This is even clearer if one considers the wording of Article 25 CPC which provides that a patent "shall confer on its proprietor the right to prevent all third parties not having his consent" from doing things.

171. *Delaware law as to the interpretation of contracts*. In *Rhone-Poulenc Basic Chemicals Co. v American Motorists Insurance Co.* 616 A.2d 1192 (1992) the Supreme Court of Delaware held that:

> "Clear and unambiguous language in an insurance policy should be given its ordinary and usual meaning. … "[W]hen the language of an insurance contract is clear and unequivocal, a party will be bound by its plain meaning because creating an ambiguity where none exists could, in effect, create a new contract with rights, liabilities and duties which the parties had not assented. ... Courts will not torture contractual terms to impart ambiguity where ordinary meaning leaves no room for uncertainty. … The true test is not what the parties to the contract intended it to mean, but what a reasonable person in the position of the parties would have thought it meant."

172. There is no suggestion that Delaware law adopts a different approach to the interpretation of contracts other than insurance contracts. On the contrary, it appears that the same approach is adopted to the interpretation of patent licences: see *Cordis Corp v Boston Scientific Corp* 868 F. Supp. 2d 342 (D.C. Del., 2012).

173. *Construction of the Agreement applying Delaware contract law*. I deal with this in Confidential Annex 3. The upshot is that the provision of the Agreement which HTC

did not have notice of makes it clear that Nokia's covenant not to sue Qualcomm is limited in ways which mean that it does not apply in the circumstances of the present case.

174. *US Federal patent law*. The first question to be considered is whether US Federal patent law comes into the question at all, even if HTC is right as to English law. It is common ground that a court in Delaware hearing a claim for infringement of a US patent would apply US Federal patent law, and accordingly it would apply the first sale or exhaustion doctrine which forms part of US Federal patent law. It does not necessarily follow, however, that US Federal patent law, or more specifically the first sale doctrine, forms part of the law of Delaware for the purposes of interpreting the Agreement, and in particular for the purposes of deciding whether Nokia has consented to acts under a UK patent or a European patent (UK).

175. As Prof Holbrook explained in his report, the US has parallel systems of State and Federal law, which are each sovereign. Each jurisdiction has its own trial and appellate courts and its own body of law. Only the State courts have general jurisdiction. Federal courts are courts of limited jurisdiction, possessing only the powers authorised by the Constitution and statute. Contract disputes, and in particular the interpretation of contracts, are typically questions of State law raised in a State court. Indeed, the US Supreme Court has held in *Kokkonen v Guardian Life Insurance Company of America* 511 US 375 (1994) that the Federal courts lacked jurisdiction over a claim for breach of contract settling a Federal court dispute. So far as US patent law is concerned, the US Congress has pre-empted State law and granted exclusive jurisdiction over matters of patent infringement to the US Federal courts. Accordingly, patent law is a Federal matter, not a matter left to the individual States. Thus the first sale or exhaustion doctrine is exclusively part of the Federal patent law of the US. Accordingly, the US Supreme Court and the Court of Appeals for the Federal Circuit have never relied upon state law in evaluating issues of exhaustion.

176. In these circumstances, Prof Holbrook stated that Delaware contract law is separate from, and does not encompass, Federal Patent law, and in particular the first sale or exhaustion doctrine. Prof Schultz agreed that Delaware contract law did not encompass Federal patent law, but said that contracts governed by Delaware law could incorporate it or refer to it. Neither of these possibilities applies here. More relevantly, he cited authority from both the Delaware and Federal courts for the proposition that parties could not use State contract law to engage in an "end run" around the first sale or exhaustion doctrine.

177. Unsurprisingly, neither expert was able to cite any authority which directly addresses the question of whether US Federal patent law should be regarded as part of Delaware contract law for the purposes of interpreting an agreement subject to Delaware law in the context of litigation which is not before a US court and does not concern a US patent. Accordingly, I have to approach the matter on the basis of the general principles outlined by the experts. Applying those principles, I do not consider that US Federal patent law forms part of Delaware contract law for the purposes of interpreting the Agreement with respect to non-US patents. I do not doubt that neither a Delaware court, nor any other US court, would allow the parties to agree to circumvent US Federal patent law; but to my mind that is a different matter.

178. In case I am wrong about that, I shall consider the issues with regard to the first sale or exhaustion doctrine.

179. Prof Holbrook stated that, in order to establish a defence to a claim for patent infringement by virtue of this doctrine, the defendant must prove (i) an unconditionally authorised first sale, (ii) in the USA, (iii) of an article that substantially embodies the patent, and (iv) for which the patentee has received full compensation. There was no issue between the experts as to (iii). Nor did Prof Schultz take issue with (i), although he differed from Prof Holbrook as to the meaning of "unconditionally". (For his part, Prof Holbrook did not dispute that a covenant not to sue may constitute authorisation for this purpose.) Prof Schultz did take issue with (ii) and (iv). The main dispute is as to (ii), and I shall focus on that.

180. As can be seen from his summary, Prof Holbrook's position was that only a sale in the USA can give rise to a defence. Prof Schultz's position was that a foreign sale gives rise to the defence when authorised by the patentee under a worldwide licence.

181. The main authority relied on by Prof Schultz was the decision of the US Supreme Court in *Quanta Computer Inc v LG Electronics Inc* 553 US 617 (2008). In that case LG licensed a patent portfolio to Intel. The licence agreement permitted Intel to manufacture and sell microprocessors and chipsets in accordance with the patented inventions. The licence expressly provided that no licence was granted to any third party to combine the licensed products with other components not obtained from Intel or the use or sale of such combinations. It also provided that nothing in it limited or altered the effect of patent exhaustion. A side agreement required Intel to notify its customers of the fact that, while Intel was licensed under the LG patents, the licence did not extend to any product made by the customers by combining an Intel product with a non-Intel product. Quanta purchased microprocessors and chipsets from Intel, and was duly notified by Intel as required by the side agreement. Quanta manufactured computers using Intel parts in combination with non-Intel parts. LG sued Quanta for patent infringement in the Federal Court for the Northern District of California. Quanta raised a defence of patent exhaustion. The Court of Appeals for the Federal Circuit rejected that defence on two grounds, first that the doctrine did not apply to method claims and secondly that exhaustion did not apply because LG had not licensed Intel to sell the Intel products for use in combination with non-Intel products. The Supreme Court unanimously reversed this decision.

182. The sole opinion was delivered by Justice Thomas. In section II of his opinion, he reviewed the history of the first sale or exhaustion doctrine, explaining:

> "The longstanding doctrine of patent exhaustion provides that the initial authorized sale of a patented item terminates all patent rights to that item."

In section IIIA, he considered and rejected LG's argument that the doctrine did not apply to method claims. In section IIIB, he considered and rejected an argument by LG to the effect that the doctrine only applied where the article sold embodied all the features of the patented invention, holding that the doctrine applied even if the article substantially embodied the patented invention and its only and intended use was in accordance with that invention. In section IIIC, he considered LG's argument that there was no authorised sale in the instant case because the licence did not permit

Intel to sell its products for use in combination with non-Intel products. He rejected this argument on the ground that nothing in the licence agreement restricted Intel's right to sell its microprocessors and chipsets to purchasers who intended to combine them with non-Intel parts. He also pointed out that Quanta did not claim the benefit of an implied licence, but of the doctrine of exhaustion.

183. For present purposes, the important aspect of Justice Thomas' opinion is what he did not say. Nowhere did he refer to the place where Intel sold the microprocessors and chipsets to Quanta. Nor did he refer to considerations of territoriality.

184. Prof Holbrook relied upon three main authorities. The first in time is *Fuji Photo Film Co. Ltd v Jazz Photo Corp* 394 F.3d 1368 (2005). In that case Jazz Photo had imported into the USA and sold refurbished disposable cameras. These cameras had been made and sold by Fuji with the intention that they be disposed of after one use. Jazz Photo's suppliers in China fitted new film into used camera shells. Only about 9.5% of the refurbished cameras derived from cameras first sold in the USA. Fuji sued Jazz Photo for patent infringement in the District Court for New Jersey. One of the defences raised by Jazz Photo was that of exhaustion (in combination with a repair defence). The CAFC held, following its earlier decision in *Jazz Photo Corp v International Trade Commission* 264 F.3d 1094 (2001), that this defence only applied to cameras "for which the United States patent right has been exhausted by first sale in the United States".

185. The other two authorities are *Fujifilm Corp v Benun* 605 F.3d 1366 (2010) and *Ninestar Technology Co Ltd v International Trade Commission* 667 F.3d 1383 (2012). Whereas the *Fuji* case pre-dated *Quanta*, both these cases post-dated it. *Fujifilm* was another case involving refurbished cameras. Again, one of the defences raised was that of exhaustion. The defendants argued that, following *Quanta*, they could rely on sales outside the USA as giving rise to exhaustion. The CAFC rejected this argument, holding that *Quanta* "did not eliminate the first sale rule's territoriality requirement". As Chief Judge Michel and Judges Mayer and Linn explained in section II of their joint opinion:

> "Defendants assert that *Quanta* created a rule of 'strict exhaustion', that the Court's failure to recite the territoriality requirement eliminated it. That case, however, did not involve foreign sales. Defendants rely on *Quanta*'s footnote 6 because it contains the phrase '[w]hether outside the country. … Read properly, the phrase defendants rely on supports, rather than undermines, the exhaustion doctrine's territoriality requirement."

186. In *Ninestar* the CAFC repeated that *Quanta* had not overruled earlier cases holding that the authorised sale must have occurred in the USA. The US Supreme Court refused to grant *certiorari*. This was despite the filing of an amicus brief by Prof Schultz and a colleague arguing that the CAFC's case law on this point was wrong.

187. Prof Schultz relied on the CAFC's later decision in *Tessera Inc v International Trade Commission* 646 F.3d 1357 (2011) as supporting his opinion, but as Prof Holbrook pointed out this decision does not address the question of whether foreign sales may be relied on to found an exhaustion defence. Rather, for procedural reasons explained

by Prof Holbrook, the appeal proceeded as if all relevant sales were made in the USA. Prof Schultz also relied on the fact that two lower court decisions have held that the first sale or exhaustion did apply to authorised sales outside the USA. As Prof Holbrook pointed out, however, these decisions are not authoritative. Prof Schultz also argued that the Supreme Court would reverse the *Fuji* and *Fujifilm* decisions if the opportunity presented itself. Prof Holbrook disputed this. Who is right about that is immaterial. At present, the law is as stated by the CAFC in *Fuji* and *Fujifilm*.

188. Accordingly, I conclude that, even if HTC is right as to both English law and the relevance of US Federal patent law (contrary to my earlier conclusions), it cannot rely on the first sale or exhaustion doctrine because in the present case the chips were not sold in the USA, but in Taiwan. Having concluded that HTC's licence defence fails for three independent reasons, I do not propose to consider the remaining requirements of the first sale or exhaustion doctrine.

Summary of conclusions

189. For the reasons given above, I conclude that:

i) claim 1 of the Patent is novel over Itakura;

ii) claim 1 is not obvious over either Itakura or Tan;

iii) each of the representative HTC devices falls within claim 1; and

iv) HTC has not established its defence of licence.

Annex 1

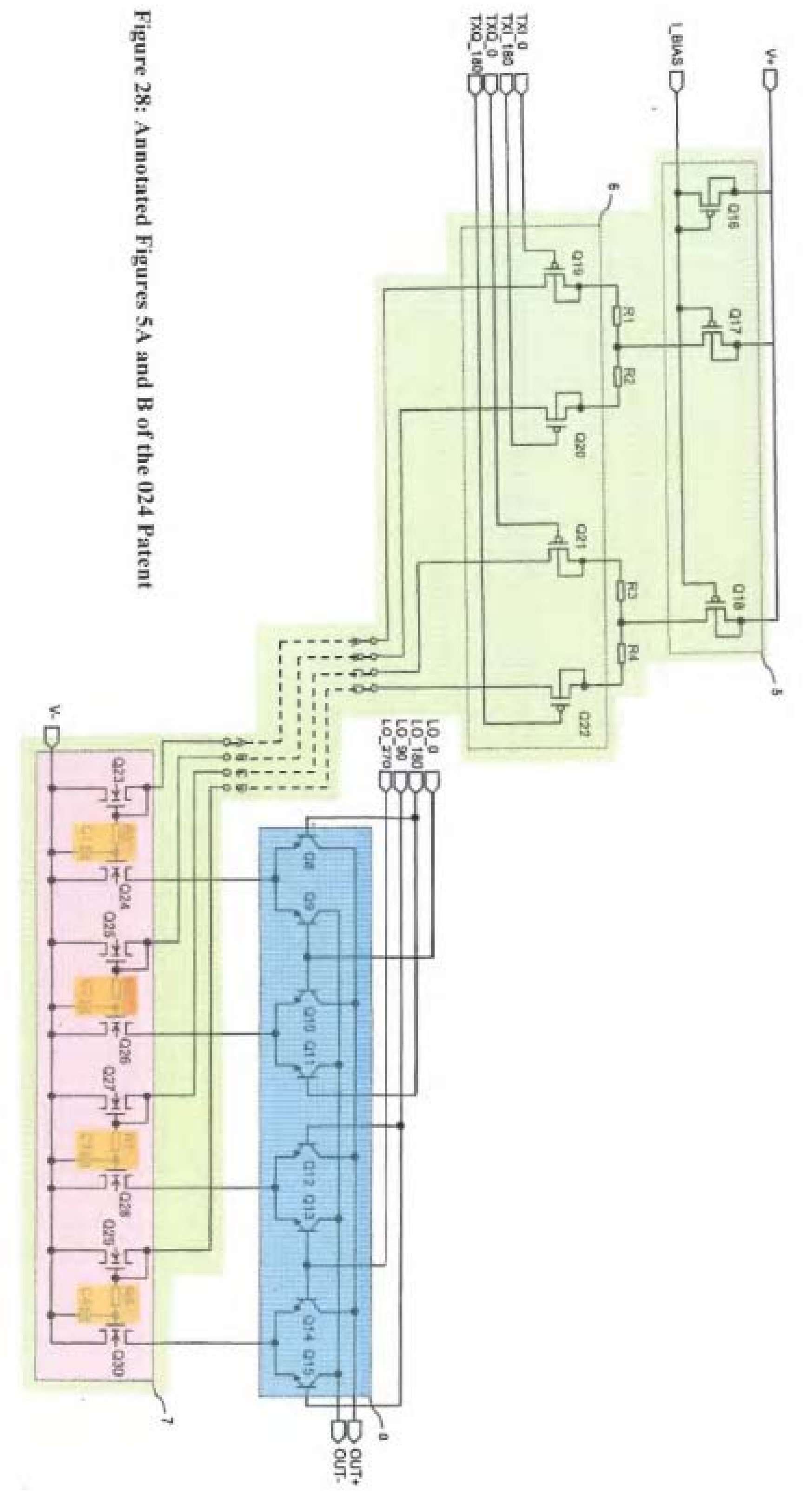


Figure 28: Annotated Figures 5A and B of the 024 Patent