AccessionIndex: TCD-SCSS-T.20251002.001
Accession Date: 2-Oct-2025
Accession By: Dr.Brian Coghlan
Object name: Fairchild resistor-transistor (RTL) chips
Vintage: 1961
Synopsis: First digital logic family to be produced as monolithic integrated circuits.

Description:
Jean Hoerni and Jay Last proposed resistor-transistor logic (RTL) [1], initially using discrete devices, but in 1961 they became the first digital logic family to be produced as a monolithic integrated circuit when Fairchild Semiconductor began manufacturing devices that used this technology as their μL900 series [2].

By 1966 the Fairchild RTL chips [3] included:

μL900	buffer-inverter
μL901	3-gate counter adapter
μL902	SR flip-flop
μL903	3-input NOR gate
μL904	half adder
μL905	half shift register with inverter
μL906	half shift register without inverter
μL907	4-input NOR gate
μL908	low-power adder
μL909	low-power buffer
μL910	dual low-power NOR gate
μL911	4-input low-power NOR gate
μL912	low-power half adder
μL913	low-power D flip-flop
μL914	dual 2-input NOR gate
μL915	dual 3-input NOR gate
μL921	low-power NOR gate expander
μL923	JK flip-flop
μL926	buffered J-K flip-flop
μL927	quad inverter
μL938	dual low-power 2-input buffer
μL940	low-power JK flip-flop
μL970	dual half adder
μL991	quad 2-input NOR gate
μL992	quad 2-input NOR expander
μL993	quad 2-input NOR gate and dual 2-input NOR expander
μL994	dual J-K flip-flop
μL995	dual buffer and dual 3-input NOR expander
μL996	hex inverter
μL997	4-bit shift register

RTL circuits were very simple, see Fig.1. The input resistor in series with a transistor base input enabled the RTL logic 1 input voltage of about 3.5V to cause the transistor base voltage to saturate at about 0.7V and hence turn ON the transistor. With two or more input resistor-transistor couplets the circuit became an active-high NOR gate or

active-low NAND gate, where the number of inputs was limited only by the leakage current of the transistors when OFF. In discrete form the big advantage of RTL was its minimal use of (then expensive) transistors, but in monolithic form this advantage was lost. The disadvantages were the power dissipation when the transistor was switched ON, and the limited fan-in of about three inputs before loss of noise immunity. Nevertheless, RTL integrated circuits were in 1961 designed into the guidance computer of the Apollo spacecraft, which first flew a remarkably short time later in 1966. But by then RTL had been quickly succeeded by diode–transistor logic (DTL), and then transistor–transistor logic (TTL).

The RTL chips in this Collection, see Figures 2 and 3, were purchased in the late 1960s by Brian Coghlan for a proposed extremely simple navigation computer (a basic Turing machine, with storage on audio cassette tape using telecomms MFC coding), for use on a proposed sailing of a classic 6-metre yacht from Dublin in Ireland back to Perth in Western Australia. In the event he went to London to undertake a PhD and neither of these proposals were realised. However, there was a sequel. As a result of the burden of calculating results, the ideas were remembered, so a CPU with a PC + stack + branching logic + arithmetic chip was prototyped, which worked so well it engendered two really useful machines [4].

Many thanks to Brian Coghlan for donating these items.

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Some of the items below may be more properly part of other categories of this catalog, but are listed here for convenience.

Accession Index	Object with Identification
TCD-SCSS-T.20251002.001	Fairchild resistor-transistor (RTL) chips. First digital logic family to be produced as monolithic integrated circuits.
TCD-SCSS-T.20251002.001.01	5 x Fairchild µL914 dual 2-input NOR gate.
TCD-SCSS-T.20251002.001.02	14 x Fairchild µL923 JK flip-flop.
TCD-SCSS-T.20250916.001	Intel 4004 microprocessor and associated chips. The first commercially successful microprocessor. 1971.
TCD-SCSS-T.20250918.001	Intel 8008 microprocessor and associated chips. Intel's first and very early 8-bit microprocessor.
TCD-SCSS-T.20250918.003	Intel 8080 microprocessor and associated chips. Intel's second and very successful early 8-bit microprocessor. 1972.
TCD-SCSS-T.20250918.004	Intel 8086 microprocessor and associated chips. Intel's very successful early 16-bit microprocessor. 1978.
TCD-SCSS-T.20250918.005	Intel MCS-48 microcontrollers and associated chips. Intel's 8048, 8035 and 8748 microcontroller series. 1976.
TCD-SCSS-T.20250918.006	Intel MCS-48 microcontrollers and associated chips. Intel's 8051, 8052, 8751, 8752, 8031 and 8032 and 8044 microcontroller series. 1980.
TCD-SCSS-T.20250918.007	Zilog Z80 microprocessor and associated chips. Zilog's Z80 superset of the Intel 8080 microprocessor. 1976.
TCD-SCSS-T.20250919.001	Motorola MC14500 microprocessor and associated chips. A very interesting 1-bit microprocessor designed for industrial control applications. 1977.
TCD-SCSS-T.20250919.003	MOS Technology 6500 microprocessor and associated chips. A highly successful early 8-bit microprocessor family. 1975.
TCD-SCSS-T.20250919.005	Motorola 6800 microprocessor and associated chips. An early big-endian 8-bit microprocessor. 1974.
TCD-SCSS-T.20250919.007	Motorola 68000 microprocessor and associated chips. A complex instruction set big-endian 32-bit microprocessor. 1979.
TCD-SCSS-T.20250921.001	Signetics 2650 microprocessor. An early 8-bit microprocessor designed by John Kessler modelled on the IBM 1130. 1975.
TCD-SCSS-T.20250921.003	Signetics 8X300. An early 8-bit microprocessor designed by SMS for signal processing. 1975.
TCD-SCSS-T.20250922.001	Intel C3000 bit-slice chipset. Intel's bipolar microcoded bit-slice processor. 1973.
TCD-SCSS-T.20250922.002	AMD 2900 bit-slice chipset. AMD's very successful bipolar microcoded bit-slice processor. 1975.
TCD-SCSS-T.20250922.003	Monolithic Memories 6700 bit-slice chipset. A bipolar microcoded bit-slice processor. 1974.
TCD-SCSS-T.20251001.001	InMOS Transputers and associated chips. Very interesting parallel processing chips comprising RISC-style stack-oriented CPU, memory, 20Mbps serial links and a realtime

	embedded kernel based on CSP process calculus. 1984.
TCD-SCSS-T.20251002.002	Motorola diode-transistor (DTL) chips. Second generation of monolithic digital logic integrated circuits. 1962.
TCD-SCSS-T.20251002.003	Texas Instruments 7400 series transistor-transistor (TTL) chips. Medium-scale-integration (MSI) logic. 1963.
TCD-SCSS-T.20251002.004	UV-erasable programmable read-only memory (EPROM) chips. Non-volatile memory for software and data storage. 1971.
TCD-SCSS-T.20251002.005	Static random-access memory (SRAM) chips. Memory that does not require regular refresh.
TCD-SCSS-T.20251002.006	Dynamic random-access memory (DRAM) chips. Memory that requires regular refresh. 1970.
TCD-SCSS-T.20251002.007	Miscellaneous digital computer and logic chips. Sundry monolithic digital integrated circuits that are not members of the other chip families in this catalog. 197x.
TCD-SCSS-T.20251002.008	Miscellaneous analog chips. Sundry monolithic and hybrid analog integrated circuits. 197x.
TCD-SCSS-T.20251002.009	Programmable logic chips. PAL, GAL, etc, integrated circuits that provide programmable logic. 1978.
TCD-SCSS-T.20251003.001	Early calculator chips. Integrated circuits for early desktop and hand-held calculators. 1971.
TCD-SCSS-T.20251005.001	Fairchild PPS25 microprocessor and associated chips. Fairchild’s first and very early 4-bit microprocessor. 1971.
TCD-SCSS-T.20251005.002	Fairchild F8 microprocessor and associated chips. Fairchild’s earliest 8-bit microprocessor. 1975.
TCD-SCSS-T.20251006.001	National Semiconductor’s COP microprocessors and associated chips. NatSemi’s earliest microprocessors. 197x.
TCD-SCSS-T.20251006.002	National Semiconductor’s SC/MP microprocessors and associated chips. NatSemi’s earliest 8-bit microprocessors. 1976.
TCD-SCSS-T.20251006.003	National Semiconductor’s 32000 series microprocessors and associated chips. NatSemi’s 32-bit microprocessors, the first with virtual memory. 1981.

References:

1. Wikipedia, *Resistor–transistor logic*, see:
   https://en.wikipedia.org/wiki/Resistor%E2%80%93transistor_logic
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2. Tekwiki, *Fairchild µL900 series*, see:
   µL900 buffer-inverter: https://w140.com/tekwiki/wiki/Fairchild_%CE%BCL900
   µL914 dual 2-input NOR gate: https://w140.com/tekwiki/wiki/Fairchild_%CE%BCL914
   µL923 J-K flip-flop: https://w140.com/tekwiki/wiki/Fairchild_%CE%BCL923
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3. Fairchild, *Fairchild Semiconductor Integrated Circuits*, see:
   https://treasures.scss.tcd.ie/hardware/TCD-SCSS-T.20251002.002/FairchildSemiconductor-IntegratedCircuitsCatalogue-1966-1632a-OCR.pdf
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4. Brian Coghlan and Graeme Taylor, *Autograph digitiser/processors*, see:
   Mk.1: https://treasures.scss.tcd.ie/hardware/TCD-SCSS-T.20251002.002/Autograph-Mk1.pdf
   Mk.1: https://treasures.scss.tcd.ie/hardware/TCD-SCSS-T.20251002.002/Autograph-Mk2.pdf
   Last browsed to on 2-Oct-2025.

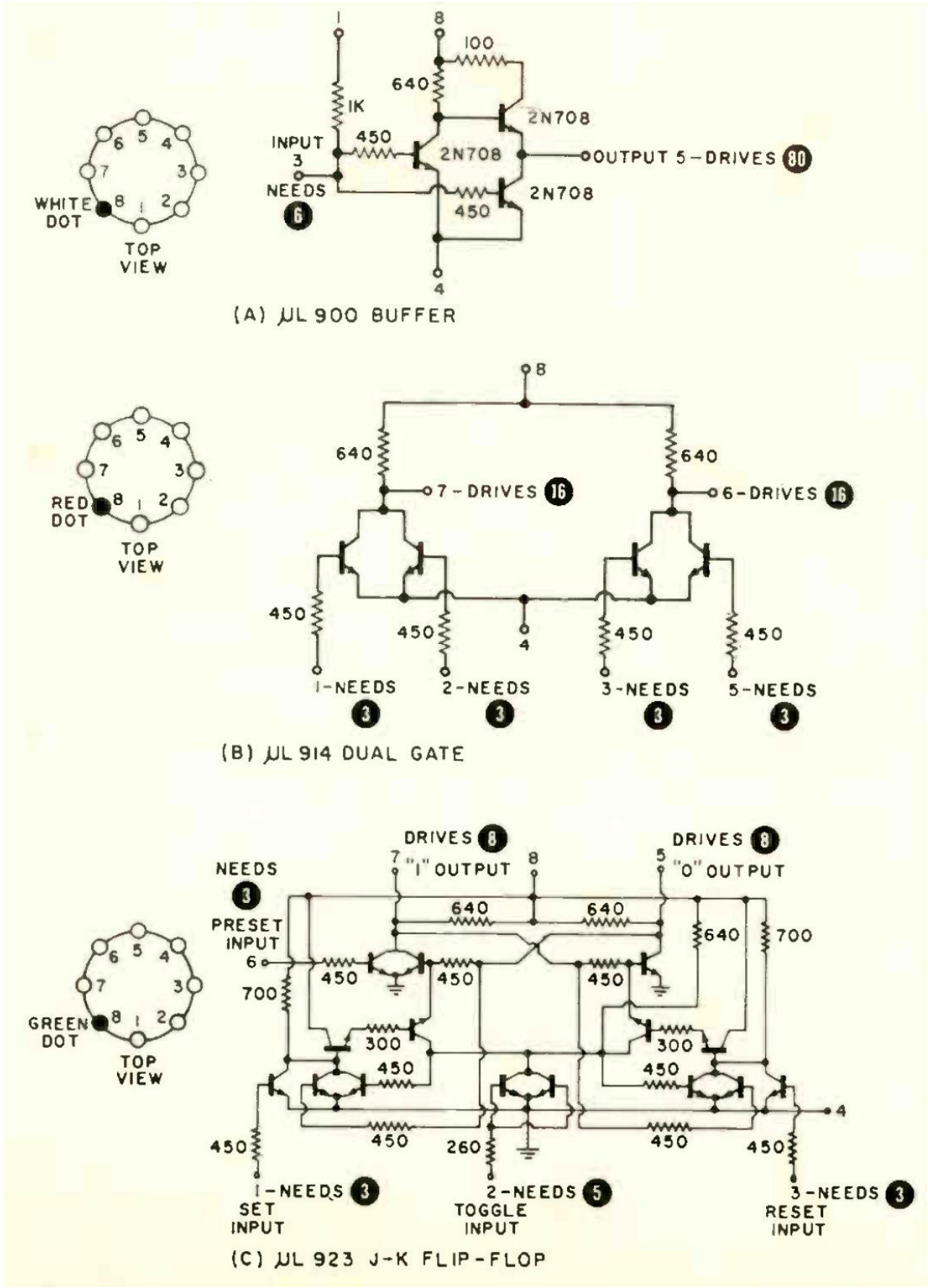

Figure 1: Examples of Fairchild RTL chip schematics

Figure 2: Fairchild µL914 chips front view.

Figure 3: Fairchild μL923 chips front view.