

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 μ L900 series [2].

By 1966 the Fairchild RTL chips [3] included:

μ L900	buffer-inverter
μ L901	3-gate counter adapter
μ L902	SR flip-flop
μ L903	3-input NOR gate
μ L904	half adder
μ L905	half shift register with inverter
μ L906	half shift register without inverter
μ L907	4-input NOR gate
μ L908	low-power adder
μ L909	low-power buffer
μ L910	dual low-power NOR gate
μ L911	4-input low-power NOR gate
μ L912	low-power half adder
μ L913	low-power D flip-flop
μ L914	dual 2-input NOR gate
μ L915	dual 3-input NOR gate
μ L921	low-power NOR gate expander
μ L923	JK flip-flop
μ L926	buffered J-K flip-flop
μ L927	quad inverter
μ L938	dual low-power 2-input buffer
μ L940	low-power JK flip-flop
μ L970	dual half adder
μ L991	quad 2-input NOR gate
μ L992	quad 2-input NOR expander
μ L993	quad 2-input NOR gate and dual 2-input NOR expander
μ L994	dual J-K flip-flop
μ L995	dual buffer and dual 3-input NOR expander
μ L996	hex inverter
μ L997	4-bit shift register

RTL circuits were very simple, amply demonstrated by [4], and 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 [5].

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 μ L914 dual 2-input NOR gate.
TCD-SCSS-T.20251002.001.02	14 x Fairchild μ L923 JK flip-flop.
TCD-SCSS-X.20250916.001	Dr.Brian Coghlan's Collection of Early Microprocessors. An extensive and nearly complete set of unused 1970s microprocessor chips, most accompanied with documentation, some with demonstration boards. 1971.

References:

1. Wikipedia, *Resistor–transistor logic*, see:
https://en.wikipedia.org/wiki/Resistor%E2%80%93transistor_logic
Last browsed to on 2-Oct-2025.
2. Tekwiki, *Fairchild μ L900 series*, see:
 μ L900 buffer-inverter: https://w140.com/tekwiki/wiki/Fairchild_%CE%BCL900
 μ L914 dual 2-input NOR gate: https://w140.com/tekwiki/wiki/Fairchild_%CE%BCL914
 μ L923 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. evilmadscientist.com, *Uncovering the Silicon: μ L914*, see:
<https://www.evilmadscientist.com/2019/uncovering-the-silicon-μL914/>
Also: <https://treasures.scss.tcd.ie/hardware/TCD-SCSS-T.20251002.002/Uncovering-the-Silicon-μL914-EvilMadScientistLaboratories.pdf>
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5. 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.2: <https://treasures.scss.tcd.ie/hardware/TCD-SCSS-T.20251002.002/Autograph-Mk2.pdf>
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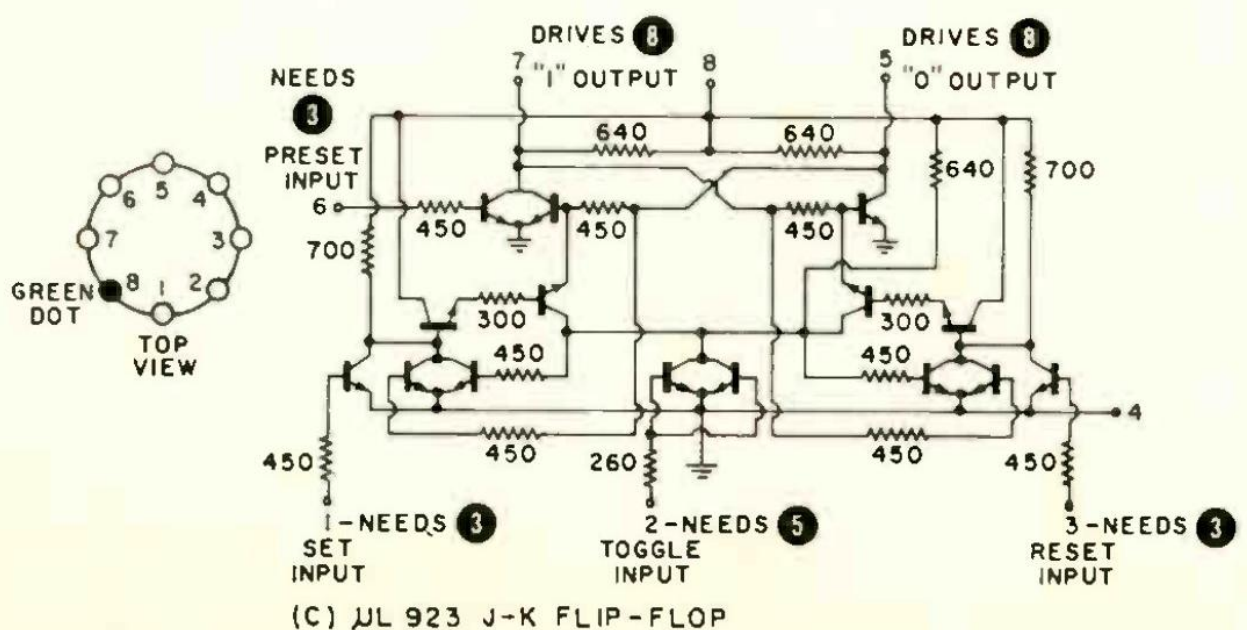
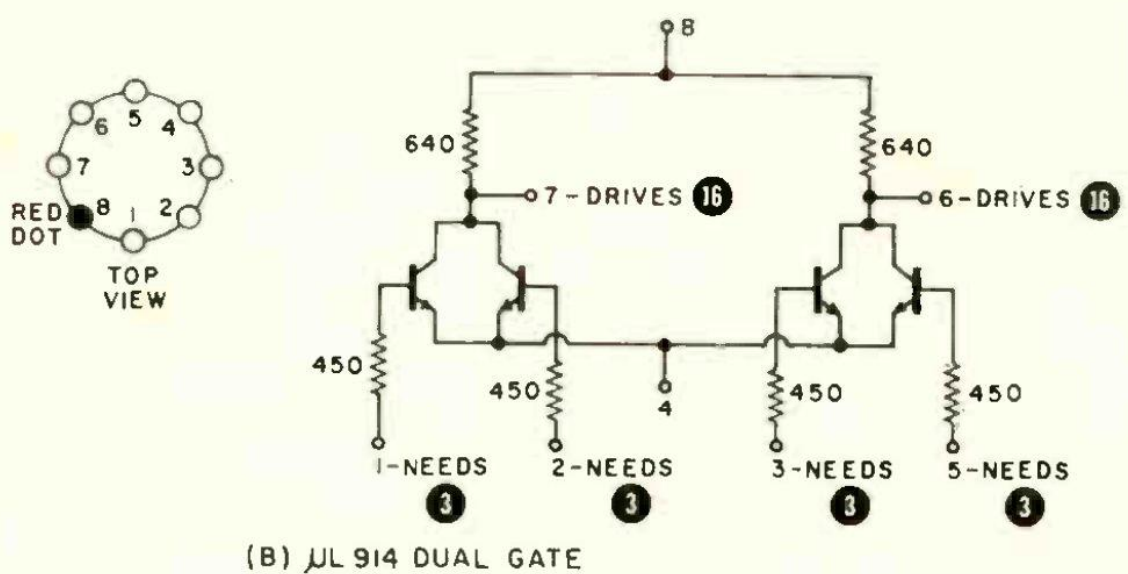
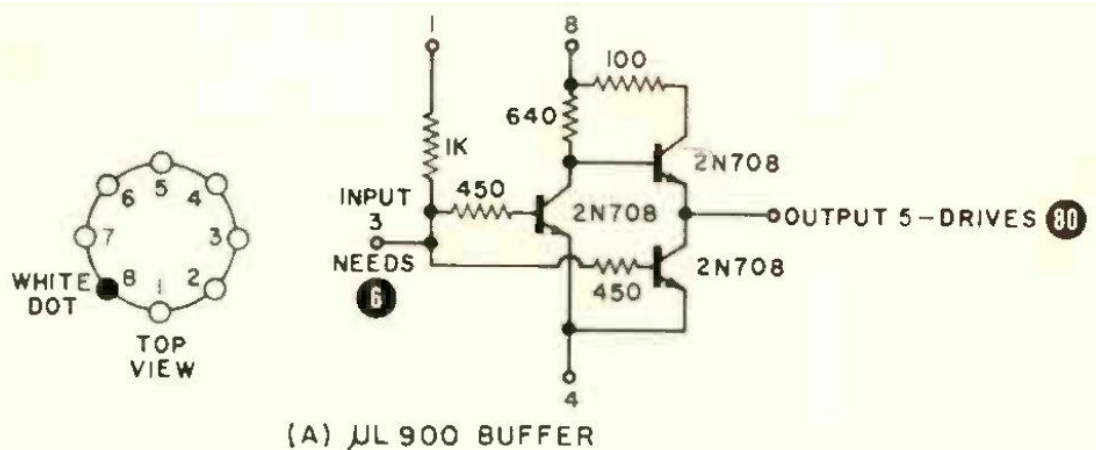


Figure 1: Examples of Fairchild RTL chip schematics



The John Gabriel Byrne Computer Science Collection
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Fairchild resistor-transistor (RTL) chips,
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Figure 2: Fairchild μL914 chips front view.



Figure 3: Fairchild μ L923 chips front view.