

AccessionIndex: TCD-SCSS-T.20251006.004

Accession Date: 6-Oct-2025

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Object name: National Semiconductor PACE microprocessors

Vintage: 1974

Synopsis: PACE-1 was the first commercial single-chip 16-bit microprocessor, based on IMP-16, which was based on the Data General Nova minicomputer.

Description:

PACE-1 was the first commercial single-chip 16-bit microprocessor [1], announced by National Semiconductor in late 1974. It was a single-chip implementation of their earlier 1973 five-chip IMP-16 architecture [2], which in turn had been inspired by the Data General Nova minicomputer.

PACE-1 (IPC-16A-520D) [3] was a pMOS chip, needing +5V and -12V supply voltages, plus a +8V substrate bias. It needed two support chips, the System Timing Element (STE) non-overlapping two-phase clock generator, and the Bidirectional Transceiver Element (BTE) interface to TTL. It multiplexed the address and data.

The PACE instruction set was implemented in microcode, and was significantly different to that of the Nova [4]. Instructions occupied just 16-bits, using relative, indexed or indirect addressing modes to generate the full memory address. A status bit allowed switching between 8 or 16 bit data operation. There were four registers but they were not identically used. There was also a 10-deep internal stack that when full caused an interrupt to allow software to extend the stack into memory, but bugs with the interrupts limited its use.

The nMOS PACE-2 (INS8900) [5] was introduced in 1977, with bugs fixed, full TTL compatibility, but needing just a single-phase clock. It still needing three voltages, +5V and -12V, but now a -8V, not +8V, bias. STE and BTE were no longer needed.

Many thanks to Brian Coghlan for donating these items.

The homepage for this catalog is at: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/>
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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.20251006.004	National Semiconductor PACE microprocessors. PACE-1 was the first commercial single-chip 16-bit microprocessor, based on IMP-16, which was based on the Data General Nova minicomputer. 1974.
TCD-SCSS-T.20251006.004.01	NatSemi PACE-1 IPC-16A/520D microprocessor.
TCD-SCSS-T.20251006.004.02	NatSemi PACE-2 INS8900 microprocessor.
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, *National Semiconductor PACE*, see:
https://en.wikipedia.org/wiki/National_Semiconductor_PACE
 Last browsed to on 6-Oct-2025.
2. National Semiconductor, *PACE-1 IPC-16A/520D datasheet*, 1974, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251006.004/NatSemi-IMP-00A-520-RALU-datasheet.pdf>
 Also: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251006.004/NatSemi-IMP16-databook-4200036A-1974.pdf>
 Also: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251006.004/NatSemi-IMP-16C-board.pdf>
 Last browsed to on 6-Oct-2025.
3. National Semiconductor, *PACE-1 IPC-16A/520D datasheet*, 1974, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251006.004/NatSemi-PACE1-IPC-16A-520D-dataSheet-1974.pdf>
 Last browsed to on 6-Oct-2025.
4. National Semiconductor, *PACE-1 Assembly Language*, 1974, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251006.004/NatSemi-PACE-AssemblyLanguage-ProgrammingManual.pdf>
 Last browsed to on 6-Oct-2025.
5. National Semiconductor, *PACE-2 INS8900 datasheet*, 1977, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/hardware/TCD-SCSS-T.20251006.004/NatSemi-PACE2-INS8900-dataSheet-1977.pdf>
 Last browsed to on 6-Oct-2025.

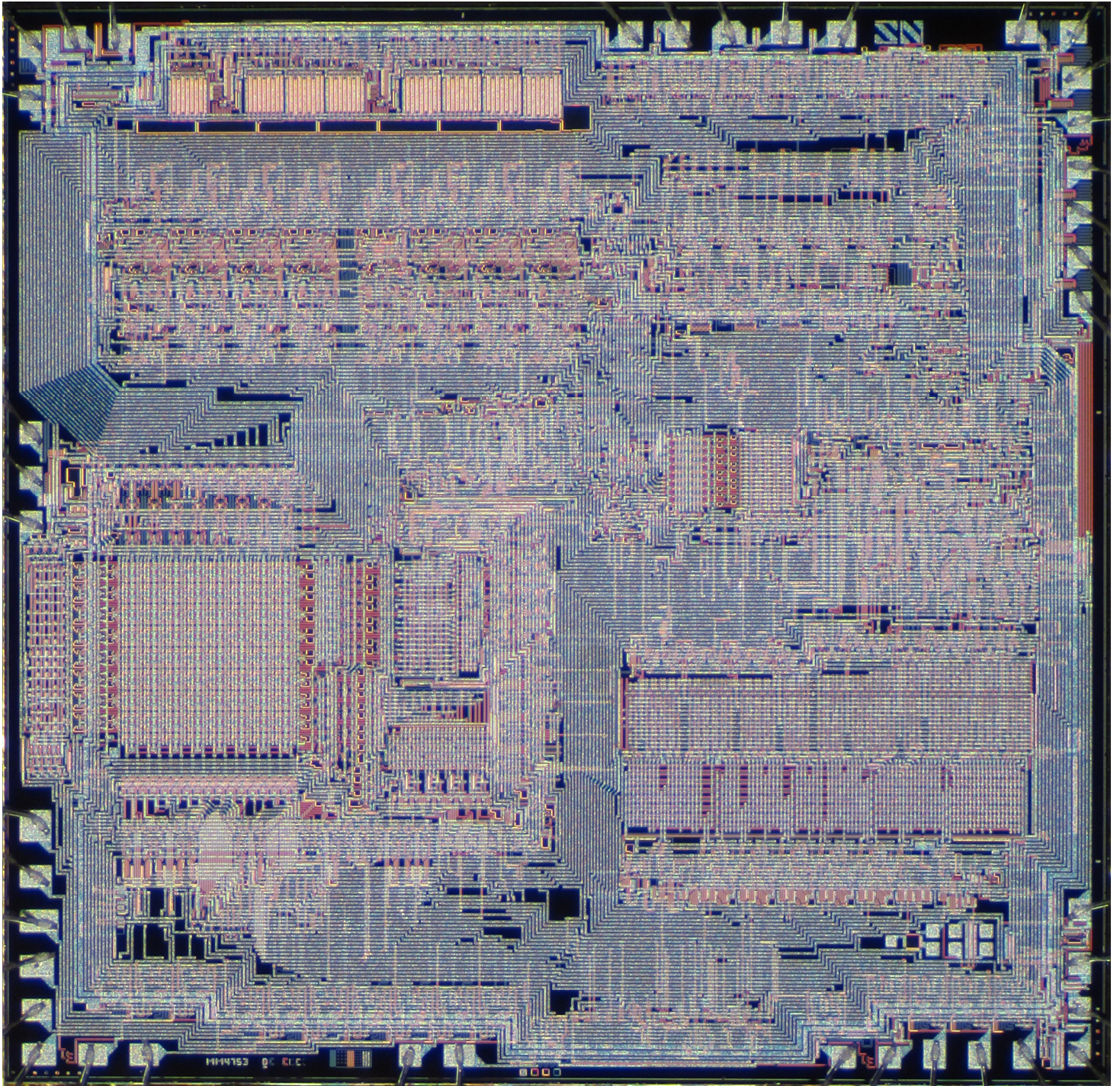
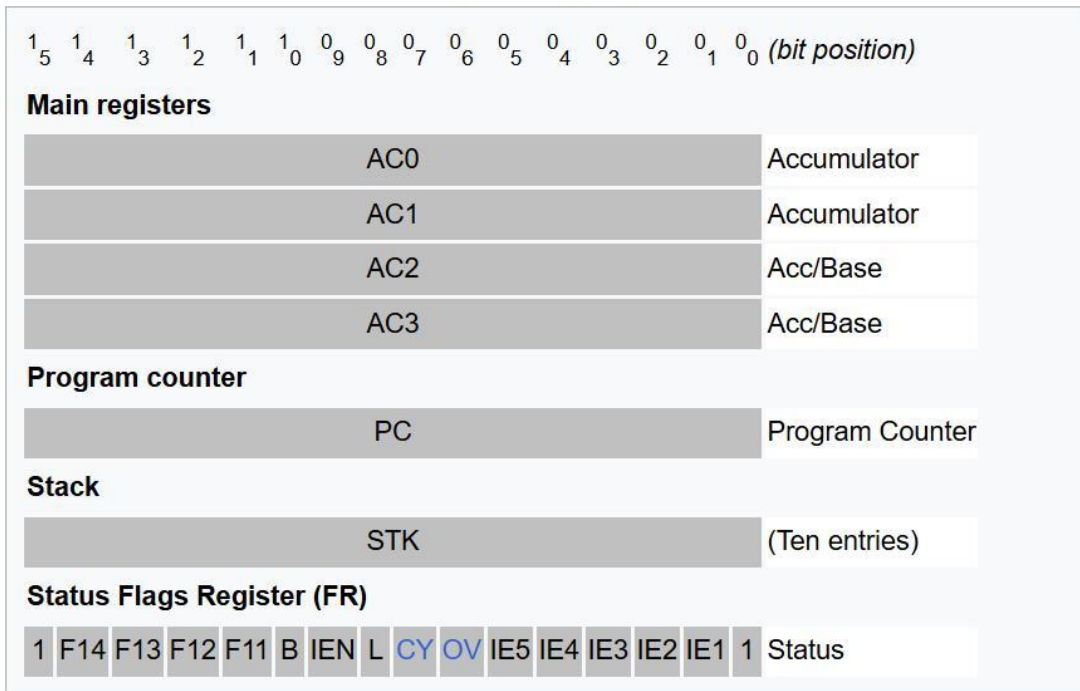


Figure 1: National Semiconductor PACE-1 (IPC-16A/520D) micrograph

PACE registers



*Figure 2: National Semiconductor PACE-1 (IPC-16A/520D) internal registers.
From Wikipedia.*



Figure 2: NatSemi PACE-1 (IPC-16A/520D) front and rear views

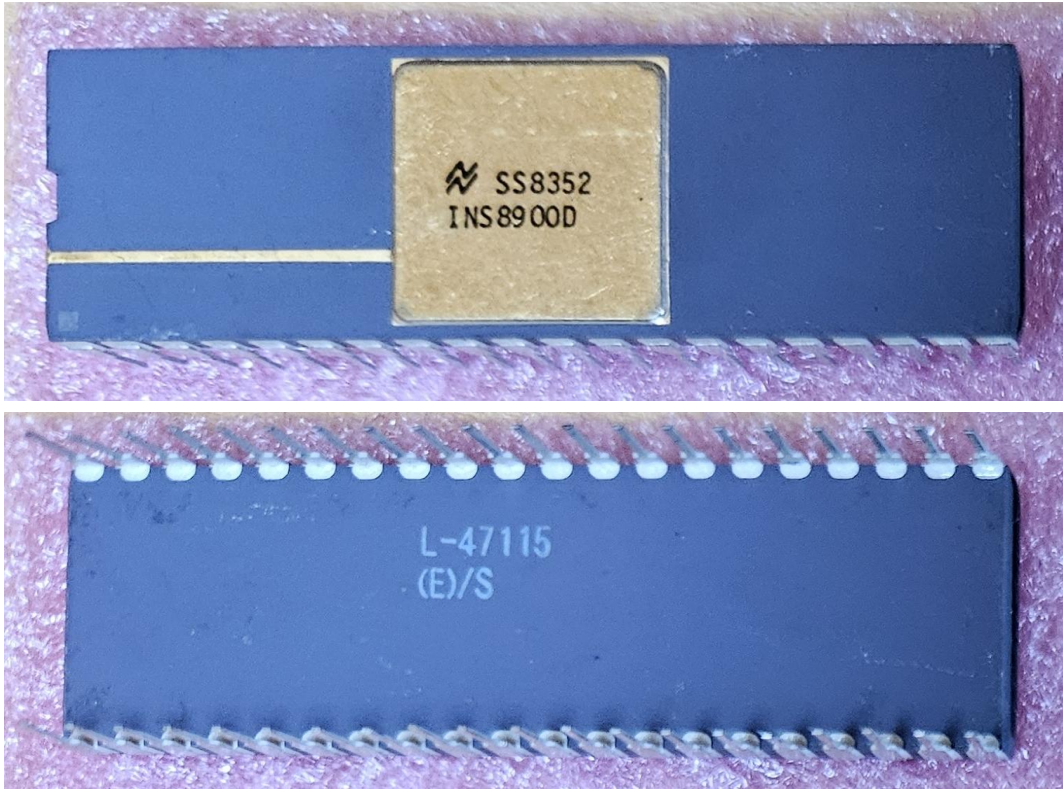


Figure 3: NatSemi PACE-2 (INS8900D) front and rear views