

Circuit Card(s) History?

Univac Guys: I was wondering if anyone knew the story of the evolution of the 2010 to 2014 cards? When I was working on the 1219's I always thought that it took that many tries to get it right. When I was scanning a CP-642B book I noticed the schematic of the 2011 card which got me thinking; always a dangerous thing.

The 2011 was single ended, that is it had one transistor pulling a resistor attached to the logic supply to ground. The 2013 has a totem pole arrangement with one transistor switching to ground and another one to -4.5 Volts. I don't know at which version that was changed.

I wonder if the change was made when they built the 1219s because they sped up to twice that of the 1218. Maybe they had to redesign the card to get it to switch faster. The other thought is heat. The 1219's were air cooled and had marginal cooling. The low value resistor pulled to ground would have made about 3X the heat of the typical card and there were many of them. Changing that one card type could have made a difference.

Did they ever do a mass 'change out' of the earlier cards on the 642's or 1218's? I know; "What difference at this point in time does it make." *Duane Craps*

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Background

The VIP Club Legacy Committee encourages Club members and browsers of our web site to ask questions or to contribute their stories. Mr. Craps was an electronics technician at the Norfolk Naval Shipyard where he worked on weapon systems using UNIVAC computers. He is now a volunteer of the Vintage Computer Federation – a group that is in the process of restoring a 1219B computer system rescued from the Johns Hopkins ‘scrap heap’. Duane sent the page 1 message to our webmaster triggering the following email messages.

Your guys would be happy to know that the last Navy 1219Bs were just turned off last year [2015]. They were at a shore site AN/SPN-42 Automatic Carrier Landing System. Duane

The Messages

November 6; Lowell to Duane @ 6:46 PM

RE: 7002010-7002014 printed circuit cards. Duane: Somewhere along the line there was a transition from germanium to silicon transistors. I don't know if that was the difference or not - I will be seeing an 'old' circuits guy on the 18th of this month, I'll ask him if he knows.

November 6; Duane to Lowell @ 7:27 PM

Lowell. Thanks, I think that the germanium transistors were on the 250XXXX cards as used in the 1206 computer era and the 700XXXX cards all used silicon transistors and were used on the 1212 and later computers.

I'll be interested to see what your circuit guy has to say. Duane

November 11; Lowell to Eight Engineers @ 7:26: AM

Hi guys: Who is the best printed circuits guy still with us? I am looking for an answer to the questions posed by an east coast guy - see message below my signature. The limit of my recollections is that there was a technology change from germanium to silicon transistors between the 642A and 642B. (or was that between the 642 service test machines and the 642A?)

Duane, the guy who sent the query, is part of the Vintage Computer Federation - there will be an article in the upcoming December newsletter about them and their 1219B from Johns-Hopkins.

Thanks for any leads that you may have. Happy Thanksgiving!

November 11; Jack Metzger to Lowell @ 8:40 PM

Lowell, the change from germanium to silicon can be determined by the logic card transistor. The change included going from PNP to NPN transistors. I was chartered to control the generation of pc cards by George Raymond to have some way of reducing the quantity of items going to Manufacturing. I also had a circuit design group that worked with vendors to generate complimentary PNP and NPN devices to use in push-pull applications when the military contractors required silicon devices. The first computer that I remember using silicon devices was UYK-7 and C-3 designs. The change increased the reliability life-time of the active devices.

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[November 11; Jack Metzger to Lowell @ 8:53 PM](#)

Lowell, the logic cards were completely redesigned between the 642A and 642B. Lee Granberg designed the logic circuits based on new, faster germanium transistors developed by Westinghouse. Both the 1218 and 1219 used the same logic cards as 642B. There were some new high fan-out cards generated for 1219, as well as faster input-output circuitry.

Hope I answered the question this time. Jack Metzger

[November 12; Lowell to Duane @ 7:29 AM](#)

Duane: Here is an explanation for the circuit changes. You have to realize that the 7002010 to 7002014 designs were about 60 years ago, at that time it was quite common to change the part number when there was a design modification, i.e. 2011 would replace 2010, etc. Here is feedback from one of the circuit engineers (amazing what we can remember from the 50s and 60s!).

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Jack mentions a complete redesign between the 642A and 642B. Also, probably the card use difference between the 1218 and 1219. Until I read Jack's words, I thought that the change from germanium to silicon was between the 642A and 642B - that thought was wrong. I knew that the logic signal levels in both the CP-642A and CP-642B were either 0V or -4.5V. Another 642A to 642B & 1218 to 1219 change was that processor memory speeds changed from an early 8 microseconds to 4 microseconds necessitating faster circuit designs for the logic. The signal levels in the machines using silicon transistors was either 0V or +2.5V. When the designs changed to silicon transistors the core memory speeds were faster too: C-3 @ 1.8 usec and UYK-7 @ 1.5 usec. There was also a change from RTL (Resistor Transistor Logic) to DTL (Diode Transistor Logic) in those time frames. Then as integrated circuits became available we had TTL (Transistor-Transistor Logic.)

I [we] also know that there was some card type commonality in UNIVAC designed peripheral devices, i.e. the 1232 I/O console had some cards from the 642A & 1218. The 1532 I/O console had some cards from the 642B/1219. The same was true of magnetic tape units, the 1240s had 642A cards and the 1540s had 642B/1219 cards. Later in time, the RD-358 mag tape units and the DEAC used some logic cards from the AN/UYK-7.

There are yet many, many stories that could be told about the evolution of technology.

The question about the 2010, ..., went out to a few other people - I'll send another message when/if I get any other feedback.

Happy Thanksgiving!

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November 12; Duane to Lowell @ 8:31 AM

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I'm pretty sure that you were right! I have attached a few pictures of a 1218 chassis, that someone was selling on eBay. They are definitely type-two 15 pin cards, the same as in the 1219 that we have.



Models of Computers mentioned herein: AN/USQ-17 (type M460), CP-642AA (type 1206), CP-642B (type 1212), CP-667, CP-789 (type 1218), CP-808 (type 1213), CP-848 (type 1219B), CP-855 (type 1230), CP-890 (type 1289) and AN/UYK-7 (type 3250)



[November 14; Jack Metzger to Lowell @ 11:02 AM](#)

Lowell, I screwed up the response in the previous E-mails. Yes, the 642B was a silicon transistor design. These pc cards were used in the 1218, 1229, and 1224 computers. Also, the UYK-7 and C-3 used the integrated circuits (1000 & 1001) as the major logic devices. I designed these integrated circuits under a Navy sponsored contract. As for the 7002010 and 7002014 cards, I believe that the 7002014 card could have been a result of a redesign by John Grape from Continuation Engineering when the original transistors became obsolete. He replaced the discrete components with integrated circuits. In some cases, he tied the ground lead to a negative voltage to get the right polarity. The performance was also enhanced.

Sorry for the screw-up, my time line was off and I'm getting older (no excuse). It became clearer to me as I thought about it. I apologize to Duane Crap for not getting it right the first time.

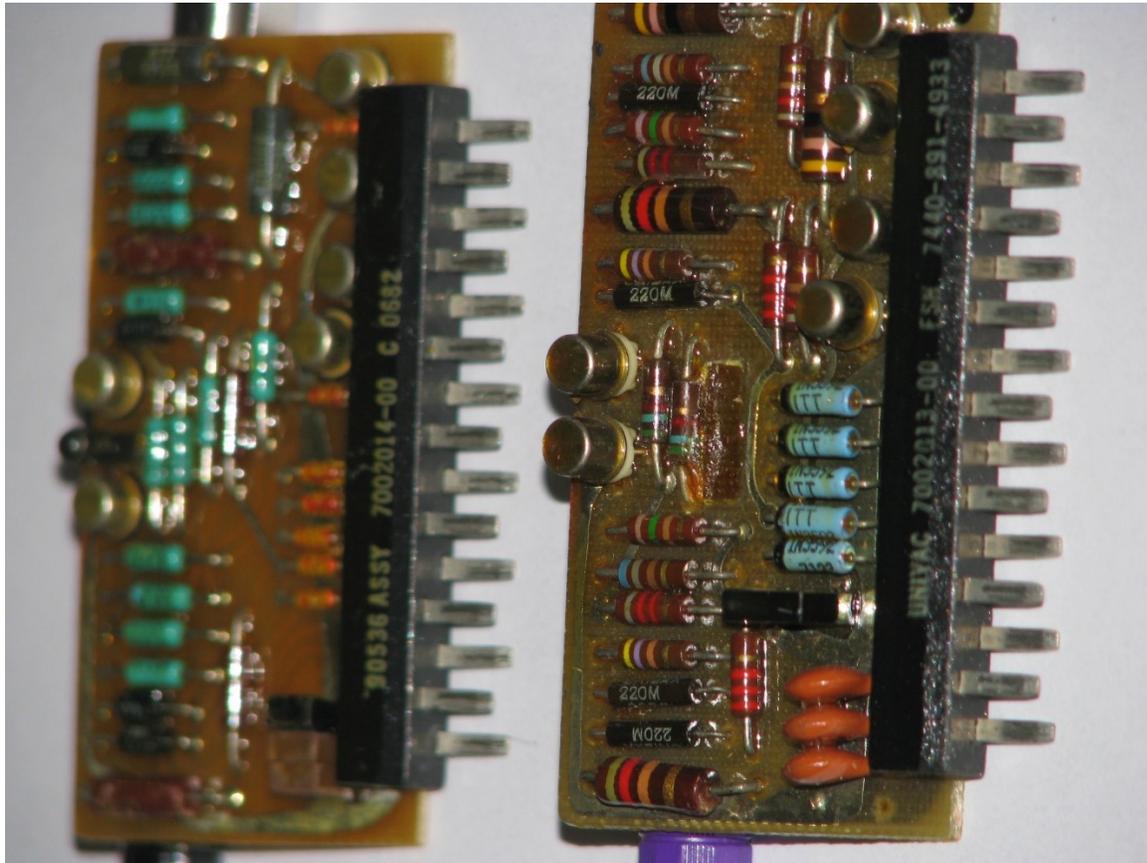
[November 14; Lowell to John Grape @ 12:14 PM](#)

John: Jack Metzger mentioned your name in the message below. Do you recall the effort which he mentions? Were there other cards redone about the same time?

[November 14; Duane to Jack Metzger @ 2:19 PM](#)

Jack; Thank you. The 2014 does indeed have smaller transistors and diodes and looks like some circuit changes. Two less resistors and two more diodes – see pictures on next page.

I think that the 642B publications were the last generation of computer books that contained the actual card schematics.



November 14; John Grape to Lowell @ 6:57 PM

My memory is getting a little fuzzy, but here is what I recall.

On request from the Navy support folks at Port Hueneme CA, we (Continuation Engineering) performed a redesign of all the 15-pin logic and I/O type cards in the 1219B. Rational was that we could no longer procure the Germanium transistors, primarily PNP, used in the original design. Our approach was to use PNP silicon devices. The Germanium devices had lower V_{be} and Sat drops, but were also less temperature stable. As it turned out Plant 4 had previously done a similar task to support commercial equipment. The redesigned cards had to meet the same parameters as the original cards. At the time, we could procure fast PNP Silicon devices which had been used in quantity by Plant 4. The 7002014 was a hi-fan-out logic driver and was one of the more challenging circuits. It required using anti-saturation and other circuit changes to meet the switching levels and speed parameters. The redesigned cards also used plated through holes on the fab boards to eliminate the cracked solder joint problems that plagued the original 15 pin cards. The 1219B utilized a newer memory design with larger circuit cards and was not part of this effort.

As I recall we originally built and tested about 5 prototypes of each card type. (I'm thinking there were about 30-40 unique card types.) We tested these and sent them to the customer for their evaluation.

After working out a few issues they accepted our designs and then requested a full 1219B complement of the new cards. After these were built the Navy folks (Roy Naboa) came to plant one and observed the installation of these cards into a 1219B and its subsequent testing in a thermal chamber over the required performance range. I'm guessing it was 0 to 50 C [editor's note: This was

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the Mil-E-16400 shipboard temperature range requirement.] The machine passed all the test requirements. I recall they also required us demonstrate that the system would perform normally when populated with a random mix of original and new type cards.

I know the Navy originally procured some types of the new cards for spares but I do not know the quantities. The 1219B was getting near the end of its useful life cycle. The other issue which came out later was that we had been required to add a switching-speed requirement to the PNP Silicon device to meet some of the card level specifications. This resulted in a selection from the standard device.

As Plant 4's usage of the device in large quantities declined, it became difficult to insure sourcing.

Jack's comments about using a negative voltage and using IC's were not applicable to this effort as all devices used were discrete transistors, diodes etc.

[November 14; Lowell to John Grape @ 8:45 PM](#)

Hey John, thank you.

You certainly recall what and why - quite well for a fuzzy memory! Was Sheldon Lange your department manager at that time or was it Gene Geisz?

[November 14; Lowell to Duane @ 9:15 PM](#)

Duane: Here is some PC card design details from John Grape. John Grape has a BEE 1966, U of MN - he and I were at a 50-yr class reunion last May.

Some days it isn't what you know but whom you know that may know what you want to learn. Cheers!

[November 14; Jack to Lowell @ 9:34 PM](#)

Lowell: I was the manager of the circuit design group before either Sheldon or Gene came on the scene. When the UYK-7 design was in progress, the company decided to move the development to Plant 1. Finley McLeod was the project engineer and he left me behind to add new people to take care of the Plant 5 design area. The people in my new group included Mel Wagner, Roger Gillette, Bob Wyland, Emmit Kuklock, Dallas Djerde, Bob Nelson, John Domka and a few others. Gene took over the circuit design for the UYK-7 and airborne projects at Plant 1. In fact, I was working for Ernie Lantto when he had Computer Development. Ernie and I were both working for George Raymond prior to this time. We did circuit and power supply design for all new designs.

[November 14; Jack to Lowell @ 10:03 PM](#)

Lowell: Neither, I had a circuit and power supply design group before they came on the scene as supervisor/ manager people. I had this group for over 10 years before taking on project engineer for the Minuteman project in 1970. People in my design group included Mel Wagner, Bob Wyland, Roger Gillette, Dallas Djerde, John Grape, Fred Mahalich, Bob Nelson, John Domka and others. Ernie Lantto and I both worked for George Raymond before Ernie moved up the Computer Engineering manager. I also spent some of this time under Dale Strand, Lee Granberg and a few others during this assignment.

I also used to do continuation engineering before Leroy Olson, and later Sheldon Lang took over the function. John Grape worked for Leroy and Sheldon and kept in touch on 15-pin card changes.

See you on Thursday, Jack

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November 14; John Grape to Lowell @ 10:23 PM

Lowell, I was under Sheldon at the time.

November 15; Duane to Lowell @ 6:34 AM

Lowell: Thanks. A lot of good information.

So far no one addressed the question of why the change from the *2011 which had a one transistor output, like most of the UNIVAC cards, to later cards which had totem pole outputs, with one transistor switching to ground and one switching to the logic supply.

Your guys would be happy to know that the last Navy 1219Bs were just turned off last year. They were at a shore site AN/SPN-42 Automatic Carrier Landing System.

November 17; Larry Bolton to Lowell @ 3:54 AM

I don't know when or what part number changes were made when the conversion from germanium to silicon took place. I will need to check my old emails to see if we have discussed this previously. See the attached for what I scanned before sending stuff to CBI. There were indexes and info about the 15 pin cards which were turned over to them. [Link to document.](#)

I do have info that indicates there were some driver cards that had a mix of germanium and silicon transistors. I will try to check old emails in the next week.

Larry Bolton

November 18; Larry Bolton to Lowell – 3 messages

#1. Sorry, I was unable to come up with any discussions of the conversion to silicon for these cards. I did find design activity from about 1960 and into about 1963 but don't know what design this is for. Jack Metzger seems to have been involved in a lot of the designs as manager. If there were silicon conversions, there may not have been significant usage since we started coming out with integrated circuits and the 56 pin cards in the late 60s.

If there were silicon conversions, I don't know what part number sequence would have been used or if a -01 would have been added to the original number. Would they have been drop-in replacements and been fully compatible? Larry Bolton

#2. Also, per data I collected about our artifacts (see my hardware database file), the cards were used as follows:

- 250xxxx used on USQ-20 and CP-642A
- 422xxxx used on USQ-20
- 700xxxx used on USQ-20B and CP-642B

The part numbering difference has mostly to do with the connector color and pin plating as defined in the sample pdf I sent on November 17th. Not on the type of transistor used.

The used-on above is what I seemed to determine. Don't take it as fact since I do not recall the source but I would not have entered it in my database if there was not some degree in confidence it was true. Larry Bolton

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#3. By the way, one of our hardware artifacts is a 7002013 Driver Amplifier designed by Bob Wyland and Jack Metzger in July 1965. This is in the range in your subject line. Larry Bolton

November 19; Lowell to Larry Bolton @ 6:45 AM

Larry: Thanks for your feedback messages about the vintage cards. As I have time during December, I hope to put together a paper combining your feedback with that from John Grape, below, and a few recollections from Jack Metzger.

I find it amazing that some recall details from 50-40 years ago, Happy Thanksgiving!

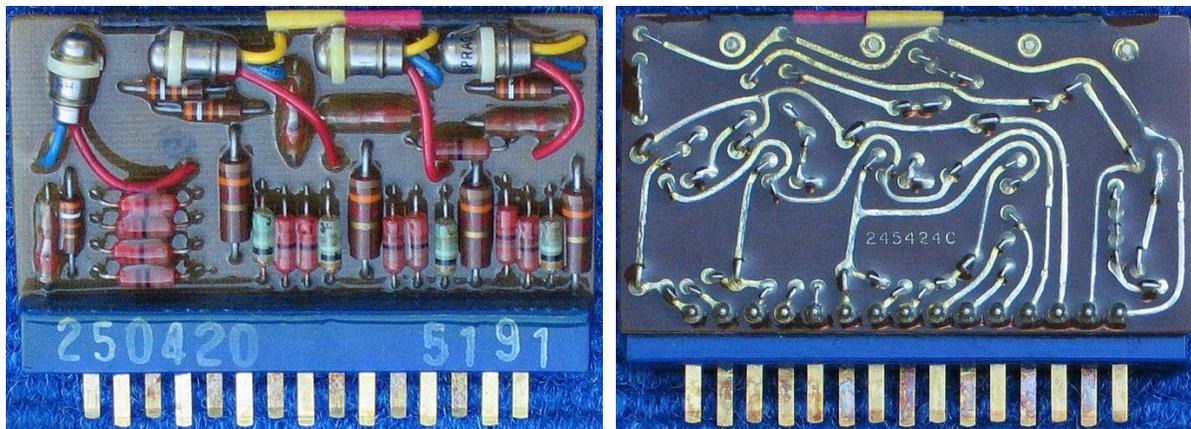
November 20; Larry Bolton to Lowell @ 7:25 PM

If you are doing something on 15 pin cards, the attached files may be useful.

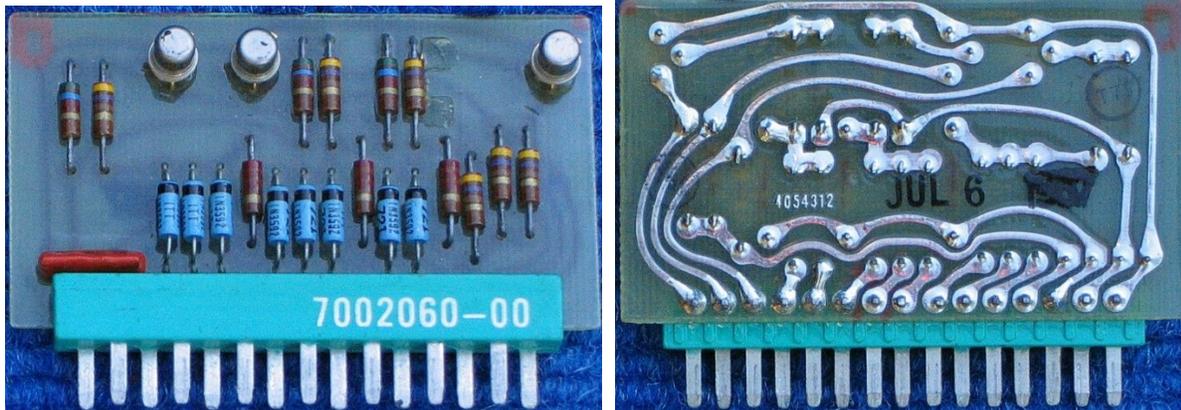
Attached is a typical parts list for a 15-pin card ([7000420 flip flop](#)) and specs for the commonly used [4908000](#) germanium transistors and [4907828](#) germanium diodes. The engineering drawing was signed off by R.[Bob] Sorensen and J. Metzger in July of 1963.

I believe the DCHS (Dakota County Historical Society – Lawshe Museum) has a bunch of the transistors that I turned over to them from the estate of Harry Wise. They could be used to repair bad cards.

The DCHS archive has an older 250420 card of which front and back photos are attached. This is an older version and the transistors are not the 4908000 type and are tall and laid down on the card. Jack and I had several discussions years ago, about what these transistors were other than that they were 520H made by Sprague.



I have also attached front and back photos of a more typical 7002060 Inverter-And 3-3-2 card. The engineering drawing was signed off by R. Sorensen and J. Metzger in July of 1963. The DCHS has at least two of these.



I do not have logic diagrams or schematics for any of these. This data is in manuals at CBI (Charles Babbage Institute.) See the pdf extract I submitted earlier as an example of what CBI was given.

When we were cataloging artifacts, I had possession of a couple manuals which I used for reference. We had to decide if the manuals should go to DCHS with the cards or to CBI where paper was going. Too bad this data is so hard to come by.

There are several 15-pin cards in the DCHS archive. I don't recall seeing any that were silicon conversions. Good luck. Larry Bolton

[November 20; Larry Bolton to Lowell @ 8:03 PM](#)

I looked at the CBI index and could not find anything other than preferred parts manuals and maybe design practices manuals. So, I checked my last hardware artifact list. Lo and behold, the manual which provided the pdf pages is at DCHS. It was in box 1008. So, if you need a resource, go to the DCHS Lawshe Memorial Museum for this manual.

I guess my better judgement took over and I did not send this to CBI unless someone did it later. Larry Bolton

Author (s)

Contributor Jack Metzger is a 1959 BSEE graduate from UND. His career included circuits design and engineering management.

Contributor John Grape is a 1966 BEE graduate from the U of MN. His career included circuits and power supply designing.

Contributor Larry Bolton is a 1965 BEE graduate from the U of MN. His career was 40+ years of component engineering.

Editor Lowell A. Benson is a 1966 BEE graduate from the U of MN. His career included computer logic design and engineering/program management.

Each of us had 30+ year careers in various computer and systems developments at UNIVAC-UNISYS-LMCO.

There is more to come about 15 pin card design variations in a future article.