

# Third slot for MSX computers

(for MSX with engine S3527 such as VG8235/45 and NMS8250/55/80)

**Original design: not well readable on my photocopy (P.M. Rooijen?)**

*Enhanced, typed in, converted to english and PDF by HansO, 2001*

**If you do not read and understand all of this, do not have previous soldering experience please do not implement this! You are warned!**

## **Why a third slot**

Slots are a severe limitation in MSX computers. Often two is not enough. A slot expander may solve most of these problems, but might be rare to buy and expensive. And not easy to build yourself. And not all hardware works in a slot expander. A compromise can be made at relative cost (a slot connector and a cheap TTL ic and a 50 pins ribbon cable) by adding a third external slot.

## **For which MSX computers**

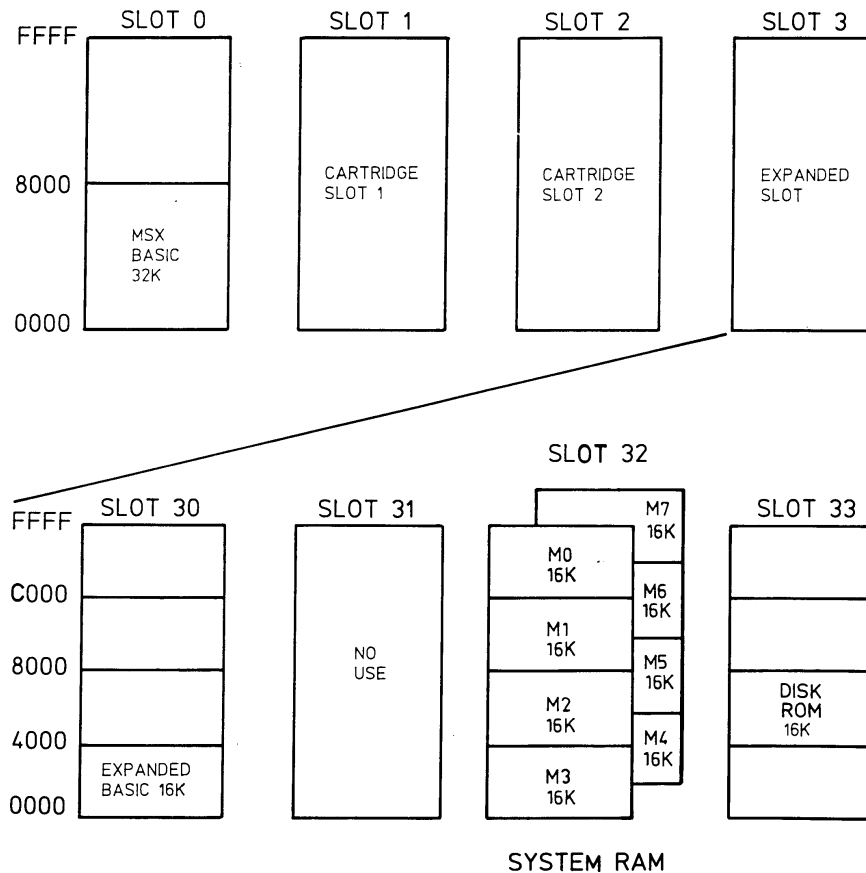
The next description is for the NMS8250/55/80 and has been built by me following the instructions from the original author.

Since the VG8235/45 are based on the same principles and chipset (the S3527) as the NMS8250/55/80 it should be applicable to these machines also. And even simpler: the busbuffers are missing from the VG8235/45 in the systems I have seen the documentation, so only the connector and cabling is required.

If and how other computers are usable is unclear. Access to the service manual is required to see if there is a free expanded slot is available and if a slot select signal for that slot can be found.

Note also the remarks later on about the BUSDIR signal.

## MEMORY LAY-OUT



*Figure 1 Memory layout of NMS8250/55/80*

By studying the service manuals and the S3527 manual you can see that the cartridge slots and 2 are using the Slot1 and slot2 select signals: unexpanded primary slots.

As you can see in the memory map above slot 31, an expanded slot in primary slot 3, is 'no use', with other words: it is free.

The S3527 delivers the slotselect for this at pin 28 (SLTO31).

So all that is needed for an extra slot (en expanded lot 31) is the physical connector with all relevant signals as on cartridge slot 1 and 2 with this slot 31 select signal.

For the VG8235/45 nothing else has to be done.

### **Buffers and BUSDIR**

The NSM8250/55/80 are basically identical to the VG8235/45 as regard to MSX engine and memory layout. Besides housing the main difference that concerns the usage of the third slot are the buffers builtin. Not only are all signals going out (address lines etc) buffered (74ls367), also the databus is buffered with a bdirectional buffer. This requires the BUSDIR signal from the external cartridge when the cartridge wants to send data to the cpu.

So for the NSM8250/55/80 at least the BUSDIR signal must be mixed with the BUSDIR signals of

the other slots. A simple swap of ttl IC's will achieve that.

To be completely in line with the NMS8250/55/80 design the slot select signal, to be named SLTSL31 in line with SLTSL1 and SLTSL2, should not be connected directly to pen 4 of the slot connector but via a buffer. Fortunately, a free buffer is available in IC169 (in at pen 2, out at 3).

### Step by step

#### NMS8250/55/80 (tested)

1. Buy a 50 pins slot connector with 2.54 mm spacing, Choose a type on which you can 'press' the ribboncable
2. Buy a piece of 50 pin ribboncable suitable for the connector.
3. Buy a 74LS15 IC.
4. Buy 2 resistor 10 K (small types)
5. Choose where you want the third connector to be. It needs some mechanical stability or you will make a short circuit in the long run.
6. Press the ribboncable to the connector.
7. Connect all pins of slot 1 (or 2) with the new connector by soldering the wires of the ribboncable to it. Leave pin 4 (SLTSL) unattached.
8. Remove IC143, a 74LS08
9. Prepare the 74LS15 IC by bending pins 1,2,3,11,12 up.
10. Solder it in the open position of IC143.
11. Connect pin 2 and the hole at pin 12
12. Connect pin 12 and the hole at pin 11
13. Run a wire from pin 28 of the S3527 SLTSL31 to pin 11 of the new IC143 and from pin 11 to pin 2 of IC169 (74LS367, see figure 2)
14. Attach pin 3 to pin 4 SLTSL of the third slot
15. Connect pin 1 of IC143 with pin 4 of slot 3 connector (BUSDIR)
16. Connect a resistor of 10K of IC143 pin 14 to pin 1
17. Connect a resistor of 10K of IC143 pin 14 to pin 3
18. Check and doublecheck all wires from point to point with a multimeter for loose connections or short circuits. Note right direction of the new connector, the signals should be present at the same locations!  
**IF YOU MAKE A MISTAKE HERE YOU WILL NEED A NEW MSX!**
19. Switch on the MSX without any cartridges and check if the MSx comes up normally working. If it does not start immediately in the usual way: switch off, say a prayer and go to step 7 and check and check.
20. Insert a cartridge in slot 1 and check.
21. Remove and insert a cartridge in slot 31. Take a cartridge that is known to work in an expanded slot!
22. Now you should have a working third slot!
- 23.

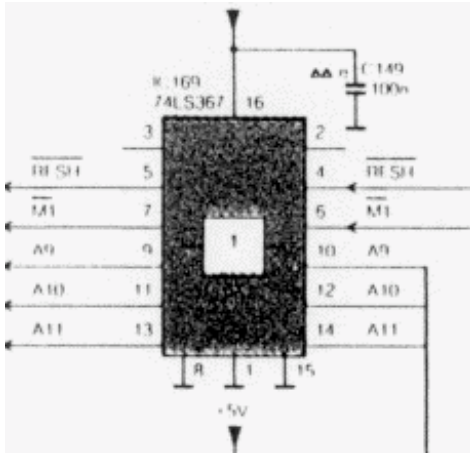


Figure 2: free buffer in IC 169

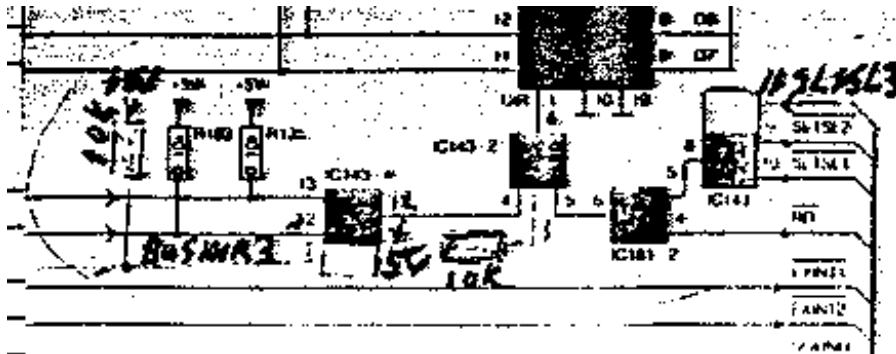


Figure 3 replace IC143 (74LS08) with a 74LS15

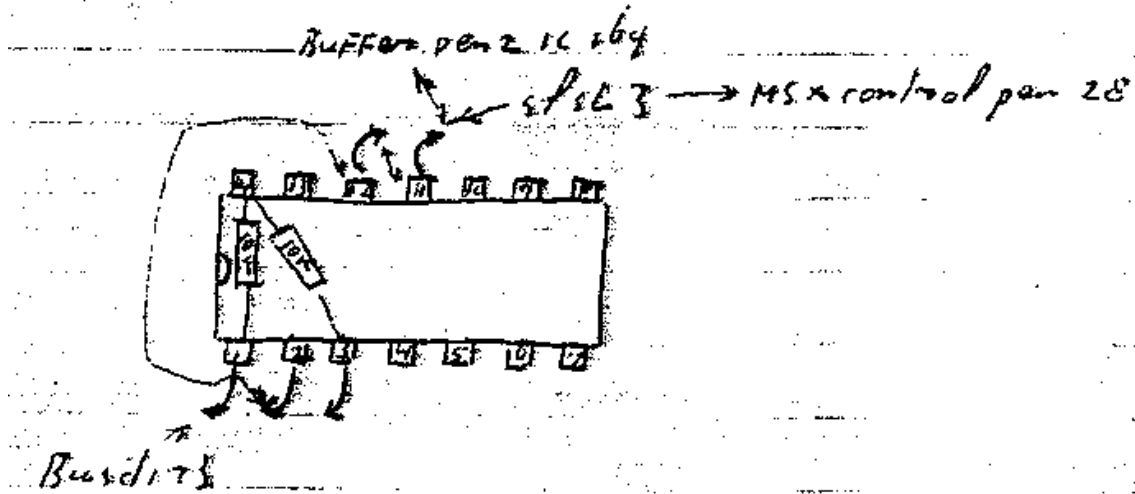


Figure 4. Connections on the new IC43

## **VG8235/45 (theory, not tested yet)**

24. Buy a 50 pins slot connector with 2.54 mm spacing, Choose a type on which you can 'press' the ribbon cable
25. Buy a piece of 50 pin ribbon cable suitable for the connector.
26. Choose where you want the third connector to be. It needs some mechanical stability or you will make a short circuit in the long run.
27. Press the ribbon cable to the connector.
28. Connect all pins of slot 1 (or 2) with the new connector by soldering the wires of the ribbon cable to it. Leave pin 4 (SLTSL) unattached.
29. Run a wire from pin 28 of the S3527 to pin 4.
30. Check and doublecheck all wires from point to point with a multimeter for loose connections or short circuits. Note right direction of the new connector, the signals should be present at the same locations!  
**IF YOU MAKE A MISTAKE HERE YOU WILL NEED A NEW MSX!**
31. Switch on the MSX without any cartridges and check if the MSx comes up normally working. If it does not start immediately in the usual way: switch off, say a prayer and go to step 7 and check and check.
32. Insert a cartridge in slot 1 and check.
33. Remove and insert a cartridge in slot 31. Take a cartridge that is known to work in an expanded slot!
34. Now you should have a working third slot!

### **Alternatives for cartridge connector location and warnings.**

The original author suggested to locate the third slot connector at slot 1 underneath the videoprint. This requires some drilling and other mechanical work and modify the housing quite a bit. It can be made quite a good mechanical solution, including the impossibility to enter a cartridge the wrong way.

Alternatives could be:

- let the ribbon cable come out of the housing and hang loose underneath slot 1 and 2. Not very stable, and dangerous: could loosen the connections, cause shortcircuits and you can enter a cartridge the wrong way **WHICH WILL DESTROY YOUR MSX!**
- Make a cartridge extender (see for example the Elektuur articles) with two connectors on the other end.

Add a connector with two pins for BUSDIR and SLTSL for slot 31 near the slots 1 and 2 and use a cable between slot 3 and this connector. Very flexible but now you can insert two cartridges the wrong way **WHICH WILL DESTROY YOUR MSX!**