

Microcontrollers Application Note #11
Flash ROM Utilization

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NEC has been working on a flash ROM (program storage) microcontroller product for several years now, and it is important for the customer to understand the difficulties in implementing this technology. The customer is also warned to carefully consider competitors' specifications before committing to a microcontroller flash ROM design. NEC's flash ROM microcontrollers are based on 0.35 micron geometry, which leapfrogs the competitions' older generation flash devices that are at 0.8 micron and thus can not compete on price with NEC.

Another important consideration is that NEC provides both the flash ROM and the mask ROM devices at the same line geometry. Therefore, if a mask ROM device is at 0.35 micron, then the flash ROM device will also be supplied at 0.35 micron. If the customer chooses to convert the flash code into a mask micro, then the code will execute identical to the flash version. This is not true of our competitors, who sometimes over a larger geometry for the flash than the mask micro, which causes correlation errors between the two software codes.

Flash technical issues have been resolved, and reliability testing by the factory has not produced any significant problems with the technology. NEC Quality Control department, however, has insisted that NEC be vigilant in preventing potential problems in the field and is insisting that ECC (Error Correcting Code) circuitry be added to the die in order to assure absolute consistent results throughout a 10 year product life. This will make NEC's flash parts the most durable and reliable on the market, but this decision has delayed some product introductions.

Flash is an important strategic product design to resolve because flash ROM microcontrollers will eventually be cheaper than OTP parts at the same geometry! Therefore, the customer gains by receiving flash devices that are field reprogrammable, which obviously OTP parts are not, at a better price. Even the current flash ROM technology with ECC will at least provide price parity, if not slightly lower pricing, than other OTP devices.

Until the release of NEC's on-board flash ROM, a customer could use external flash devices to store the program code. However, in circuit programming becomes a very costly proposition for this type of scenario. The main problem is that each segment of the flash memory must be isolated with buss isolation, which will require extra circuit board traces and ICs to reroute the buss so that the microcontroller could control the flash programming algorithm.

If the customer still wants to use external flash ROM devices, then another NEC proprietary technique exists for self reprogramming. The flash bootloader program can be executed in the top 1K of RAM (so called hidden ROM), while the external flash ROM device is being reprogrammed. This technique is an acceptable two chip solution, but it is not as cost effective as a single chip flash ROM device.

It is unclear how competitors are guaranteeing their flash write/erase cycle claims. NEC guarantees 20 write/erase cycles which means that if the user programs a device less than 20 cycles, then that device is guaranteed to retain its program contents for a minimum of 10 years *over the full temperature range*. The user may successfully program a device 40 times, but NEC will not guarantee that the contents of that device will be retained for 10 years. Therefore, for development, the engineer can program the flash device until it dies, which may be several hundred cycles, but just make sure that this device does not ship into the field. Some of NEC's competitors have announced that they are developing 1K write/erase cycle flash devices, but they do not mention that a device which experiences 1K cycles will probably not retain data for 10 years. Note that EEPROM technology is widely used in industrial/automotive applications, and that technology is rated for 10 year data retention life which is identical to NEC's flash rating.

Also, NEC will guarantee the 20 write/erase cycles for 10 year retention over the full temperature range. Other competitors might increase the number of write/erase cycles or the retention life, but they only do it for a nominal temperature such as room temperature. NEC retention life can be increased with de-rated operating temperatures.

The flash technology that is used for flash based microcontrollers is floating gate, or sometimes called simple gate, technology. This technology is very different than the flash technology that is used for conventional flash memory devices. Floating gate flash technology reduces die area but it also reduces the data retention life and maximum programming cycles.

Floating gate flash requires the use of an insulator, and the thickness of the insulator trades off certain parameters of the flash. A thicker insulator provides longer data retention life, but it also requires larger currents to program the flash memory.

Larger programming currents have the following disadvantages:

1. Drastically longer programming time, which eventually leads to a more expensive system cost.
2. Increase infant mortality rates of the devices, which means the user will receive some devices which simply will not program.
3. Larger currents increases localized heating of the die which can lead to premature failure of the die.

With customer input from several large customers, NEC has determined to fix the following parameters: 10 year retention life with less than 20 programming cycles for operating temperatures up to 85°C. The process has been optimized for these parameters and can not be adjusted. However, if customers will not operate the devices up to 85°C, then NEC can de-rate the retention life or the number of programming cycles.

End of Life failure is achieved for devices that have been programmed ≤ 10 years and have been operated at $\leq 85^{\circ}\text{C}$ after programming. Also, the programming iterations is being limited to 20 or less. Programming more than 20 times causes SILC (Stress Induced Leakage Current) failure modes which causes reliability issues. Programming the device causes charges to tunnel through the 100 angstrom oxide layer, and the holes can become trapped in the oxide layer. The trapped holes can provide a leakage path for the flash charge to bleed off, which can reduce the 10 year retention life. SILC is worst at room temperature because at elevated temperature the oxide can actually anneal or cure itself.

Mask ROM product migration is important for high temperature applications since the flash junction temperature is rated only to about 100°C. Therefore, for extended temperature applications, the user might consider prototyping with flash devices and then switching to a masked device for full production. Therefore, the user needs to consider NEC's leadership in both flash and masked technology for these high temperature applications.

First Flash Programming Method:

There are several ways to program flash ROM device. The first method would

involve programming the devices off-board in a programming socket. This approach requires the use of a Flash Pro Three (FL-PR3), which has now been released and will program up to 256K flash. A specific device file is required in order to use this programmer, which was not required for FL-PR2. A programming adapter (socket) is required in order to use the programmer. Discussions are under way with Xeltek to provide a less flexible solution for \$500.

Steps to diagnose the flash ROM connection: 1) run the diagnostic software and perform a silicon signature on a device and verify that it reports locating the proper device, 2) erase the flash device, 3) set the proper RAM block size, and 4) program the devices. The Flash Pro programmers default to a RAM block size of 256, which is correct for a K0 device. To program a K0s device, the RAM block size must be adjusted to 128 bytes otherwise an error will occur while trying to program the device, even though the silicon signature will be performed correctly.

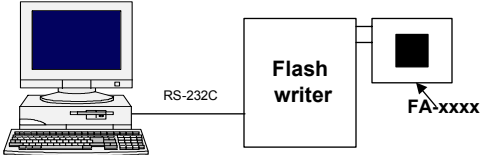
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Flash ROM Programming

Method 1: Socket Programming

At first, we need the flash writer(FL-PR3).

Method 1:
To write the program by using the programming adapter(FA-xxxx).



Device	Package	FA-xxxx	Device	Package	FA-xxxx
78F9116CT,78F9136CT	26pin SDIP	FA-28CT	78F9418GC,78F0058GC	80pin QFP	FA-80GC
78F9116GS,78F9136GS	30pin SSOP	FA-30GS	78F4046GC		
78F9026CU	42pin SDIP	FA-42CU	78F9418GK,78F0058GK	80pin TQFP	FA-80GK
78F9026GB	44pin QFP	FA-44GB	78F4216GF,78F4218GF	100pin QFP	FA-100GF
78F0034GC	64pin QFP	FA-64GC	78F4126GC,78F4218GC	100pin TQFP	FA-100GC
78F0034GK	64pin QFP	FA-64GK			
78F0034CW	64pin SDIP	FA-64CW			

K Series

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Second Flash Programming Method:

A second approach would be to program the flash ROM devices in-circuit, while the device is soldered down on the PCB board. This approach also requires the use of a Flash Pro Three (FL-PR3), although the customer could also use another NEC microcontroller to provide the proper programming pulses. The Flash Pro3 is easily available from NEC, and the NEC Multi Use Board contains

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a working demonstration of a NEC microcontroller reprogramming another flash ROM based microcontroller. Programming of the device, in this fashion, can be accomplished with either the I2C, UART, or 3 wire serial ports. Flash Pro3 supports all the different modes, which are selected on the user interface menu.

Either way, a good in-circuit programming implementation would feature a header to access the required control signals. Also, be sure to include a switch on the Vpp pin to connect the pin directly to the header during programming, otherwise ground the pin during normal operation. The initialization procedure involves setting Vpp to 10V, setting the reset vector, then pulsing the reset pin so that the micro recognizes that a program cycle has been requested.

The 9 pin flash programming connector on the Flash Pro3 and Low Cost Emulator (LCE) are all identical. Unfortunately, the 15 pin connector on the Flash Master is not compatible with the 9 pin connector, but an adapter cable can be made since the same signals are used. The connection from the D-sub flash port to the device is shown in the datasheet for the flash device. This pin out can sometimes change from device to device, so it is best to consult the datasheet.

Note, the 50 pin connector on the Low Cost Emulator (LCE) that is used for in-circuit debug **can NOT** be used for flash programming. The 9 pin connector, although it connects to the same pins as the in-circuit emulation probe, contains extra hardware for timing and verification. Therefore, the user must program from the 9 pin connector of the LCE.

Note that the datasheet shows the pin connections for every device. However, the following two pin connections need to be decided by the user.

CLK signal from the programming tool. The CLK signal can be provided by the programming tool, but the frequency of the programming tool will interfere with the on board crystal. Therefore, the crystal has to be isolated from the CLK trace to the programmer otherwise improper operation will result. Therefore, the user will have to put jumpers to the crystal and to the clock signal. In most cases, it is best to use the on board crystal. However, the following three cases make sense for wiring up the CLK signal.

1. The crystal is not soldered down while programming the microcontroller. This is a rare condition because adding the crystal would require a secondary soldering operation.
2. The flash programming frequency is different from the normal operating frequency. Please check the flash programming frequency in the datasheet, but this was usually a problem with older generation flash technology. Most new devices can be programmed with the same

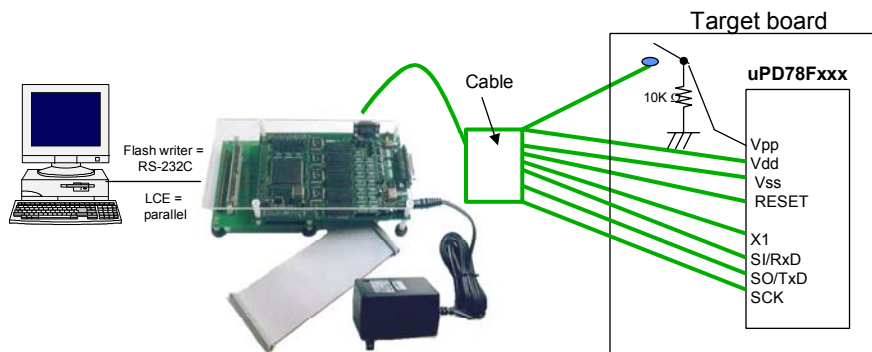
frequency as the operating frequency.

3. The user wants to program at a different frequency than the operating frequency. For instance, the user might want to program at 5MHz, while the device normally operates with a 1MHz crystal. The user will notice very little programming time difference between 5MHz and 1MHz. However, a programmer can be used to verify the programming times.

The user also has to make a decision about the Vdd signal. The Flash Pro and Flash Master devices can work with either the Vdd from the signal board or from the programmer. The user can decide if all the voltages should be provided by the programmer or if the Vdd will work from the on-board supply (external Vdd setting on the programmer). For LCE applications, the Vdd MUST be supplied by the LCE, so the signal needs to be wired from the device.

NEC Flash ROM Programming Method 2: On-Board Programming (pg2)

The Flash Pro3 and Low Cost Emulator have a compatible 9 pin D connector.



For actual pin connections, refer to the datasheet of the flash device. The pin connections for the Flash Writer, and LCE are identical. Flash Master is a 15 pin connector.

K Series

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Flash Programming Connectors

Low Cost Emulator



Flash Pro3



**9 pin
 D-sub**

KOREwriter



2 row header

Flash Master

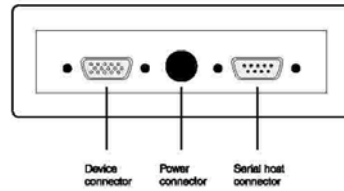


Figure 3: flashMASTER connectors

**15 pin
 D-sub**

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Flash Programming Connector

9 pin D-sub
Low Cost Emulator

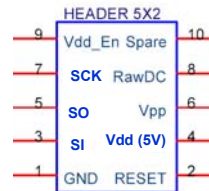
Table 5-1. Pin Configuration of the LCE-K0S DB9 Connector

Pin	Signal Name	Specification
1	GND	Ground
2	SI	Serial data input
3	SO	Serial data output
4	SCK	Serial clock output
5	CLK	Clock output to target
6	RESET	RESET signal output to target (active low)
7	VDD	VDD input/output to target
8	VPP	VPP output to target
9	-	

9 pin D-sub
Flash Pro3

Pin	Signal name	IN/OUT	Specification
1	GND	--	Common signal
2	SI (Rx/D)	IN/OUT	Serial data I/O (3-wire, UART, IIC)
3	SO (Tx/D)	OUT	Serial data output (3-wire, UART)
4	SCK	OUT	Serial clock output in 3-wire, IIC mode
5	CLK	OUT	Clock output to target (Select 16, 8, 4, or 2 MHz.)
6	_RESET	OUT	RESET signal output to target (Low: RESET ON)
7	Vcc	IN/OUT	Vcc input/output to target (Select I/O with select switch.)
8	Vpp	OUT	Vpp output to target
9	HS	OUT	Handshaking signal output of 3-wire + handshaking communication

KORE Writer
Flash Pro4 **Header**



Flash Master **15 pin D-sub**
Flash Pro4

Target cable 1	flashMASTER HD-Sub 15	Signal name at flashMASTER
1	15	GND
2	4	/RESET
3	2	SI / Rx/D
4	8, 9	Vcc
5	1	SO / Tx/D
6	11	Vpp
7	3	SCK
8	7	(*)
9	14	CLK
10	13	(*)

Table 2: Pinout of target cable 1
(*): Reserved for future use, leave open!

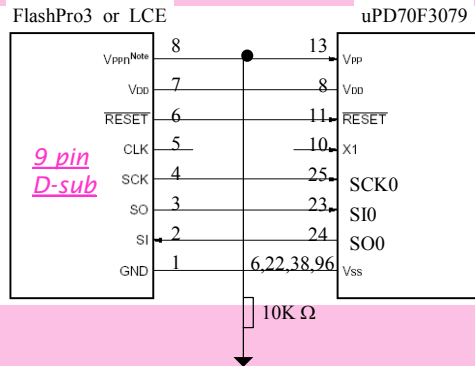
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Now, some schematics for actual Flash devices. However, please read through these quick comments.

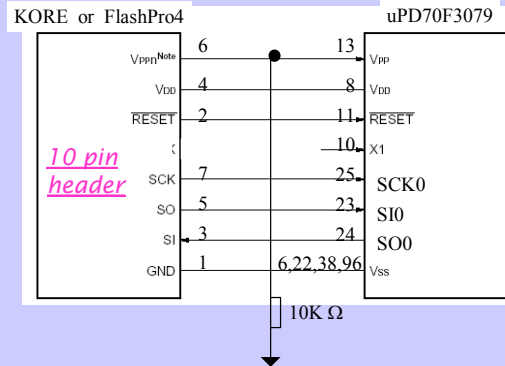
1. For the most part, these schematics are intended for in-circuit programming use.
2. Similar schematics will be used for the Flash Adapter, however, in most cases, the Flash Adapter will require connecting the CLK/X1 signal since the Flash Adapter does not have an on board crystal. So, the Flash Programmer has to provide that clock.

NEC uPD70F3079 Flash Programming Connector

uPD70F3079 with FlashPro3 or LCE



uPD70F3079 with KORE/Flash Pro4 header



- ❖ Need to select CSI0 mode on the programmer.
- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

Top view of PCB connector to Mate with KORE/FP4 header

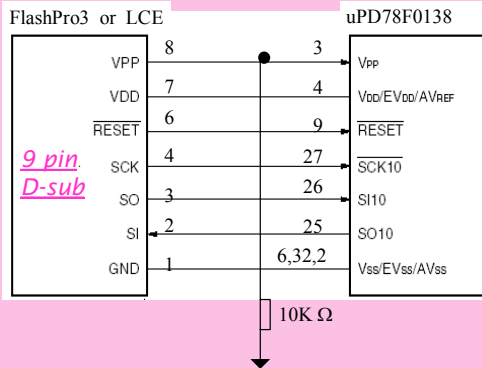
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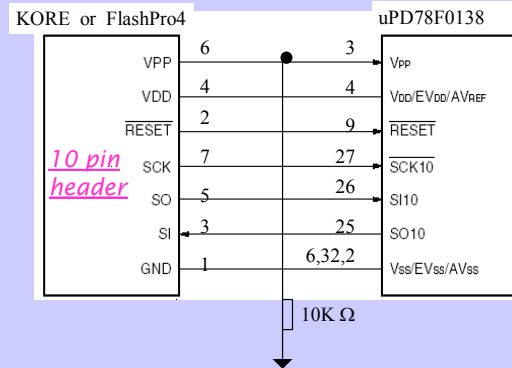
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NEC uPD78F0138 Flash Programming Connector

uPD78F0138 with FlashPro3 or LCE



uPD78F0138 with KORE/Flash Pro4 header



CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

Top view of PCB connector to Mate with KORE/FP4 header

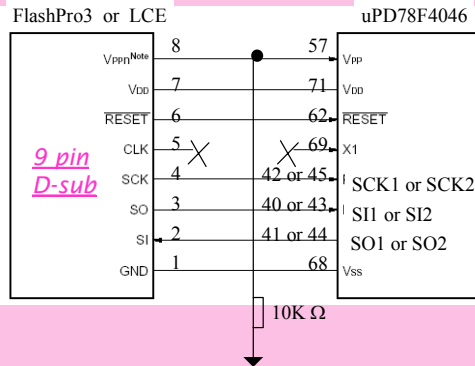
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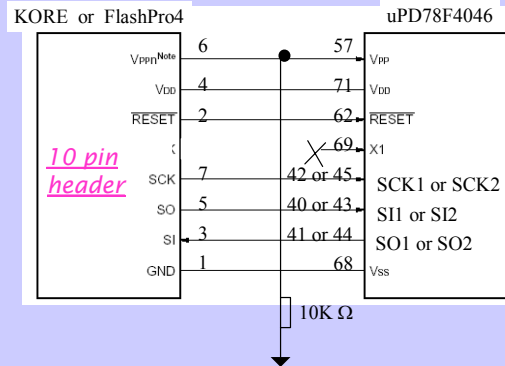
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NEC uPD78F4046 Flash Programming Connector

uPD78F4046 with FlashPro3 or LCE



uPD78F4046 with KORE/Flash Pro4 header



CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

Top view of PCB connector to Mate with KORE/FP4 header

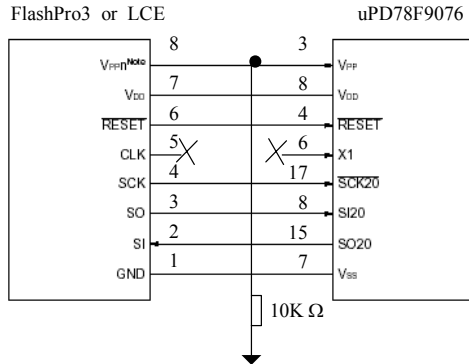
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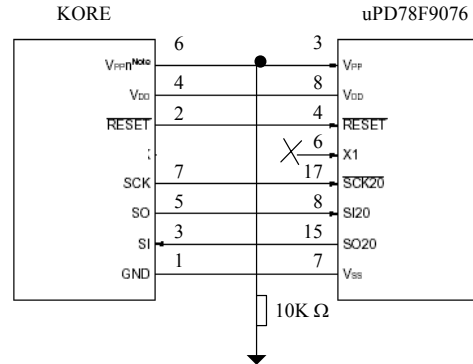
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Flash Programming Connector

[uPD78F9076 with FlashPro3 or LCE](#)



[uPD78F9076 with KORE/Flash Pro4 header](#)



[Top view of PCB connector to Mate with KORE/FP4 header](#)

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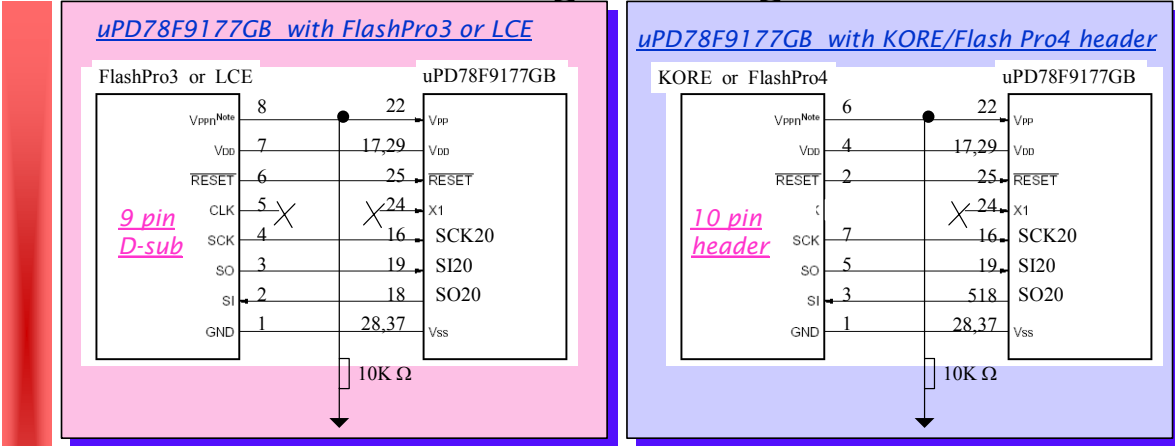
■ CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

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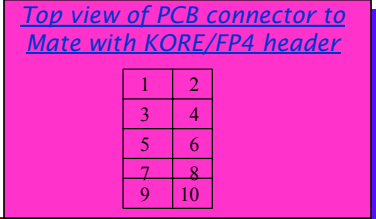
NEC

NEC uPD78F9177GB Flash Programming Connector



CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

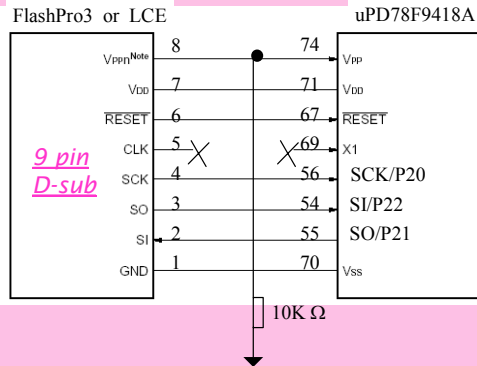


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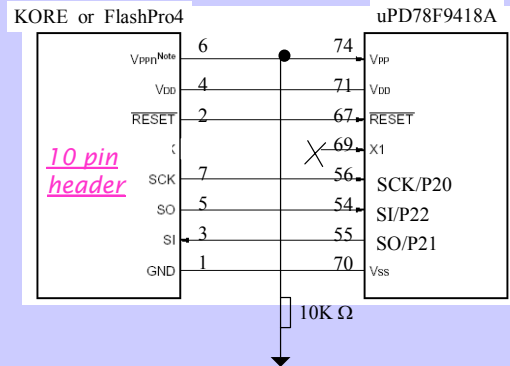
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NEC uPD78F9418A Flash Programming Connector

uPD78F9418A with FlashPro3 or LCE



uPD78F9418A with KORE/Flash Pro4 header



CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

Top view of PCB connector to Mate with KORE/FP4 header

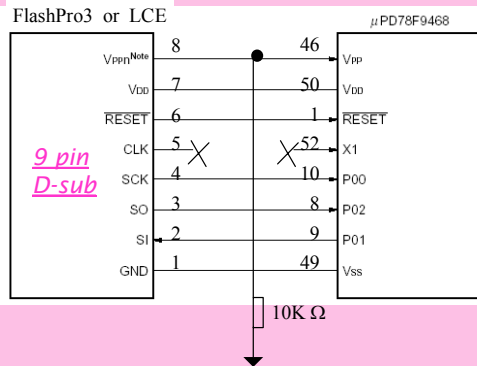
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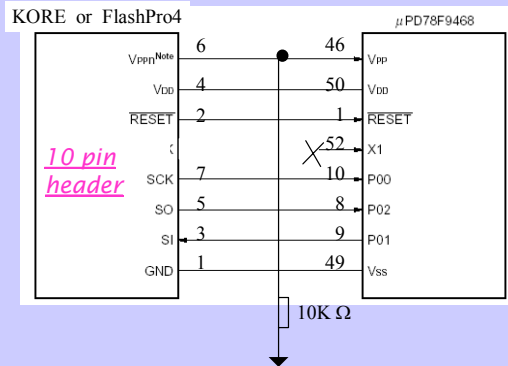
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NEC μ PD78F9468 Flash Programming Connector

[uPD78F9468 with FlashPro3 or LCE](#)



[uPD78F9468 with KORE/Flash Pro4 header](#)



CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

[Top view of PCB connector to Mate with KORE/FP4 header](#)

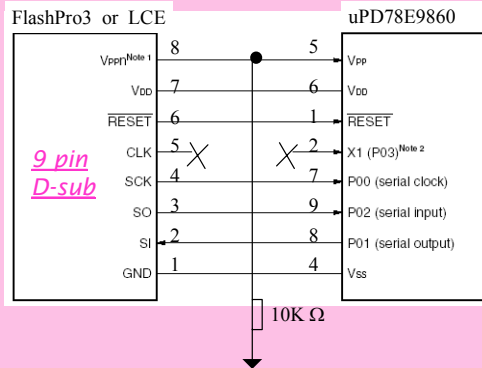
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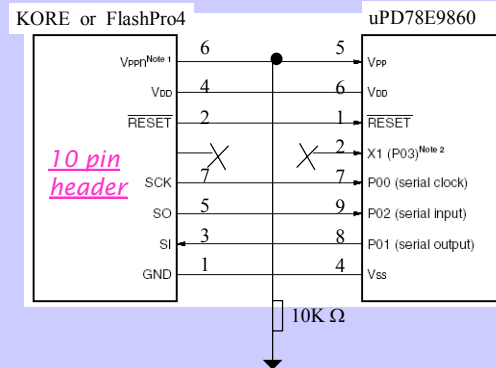
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NEC uPD78E9860/1 Flash Programming Connector

uPD78E9860/1 with FlashPro3 or LCE



uPD78E9860/1 with KORE/Flash Pro4 header



- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.
- ❖ CLK pin (X1/P03) is only available on the 78E9861 device

Top view of PCB connector to Mate with KORE/FP4 header

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7	8
9	10

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Third Flash Programming Method:

Have an in-circuit tester provide the proper waveforms to the device being programmed. This eliminates the Flash Pro3 for production purposes. However, note that your expensive in-circuit programmer will be tied up programming devices, a function which less expensive programmers could be performing. In addition, programming devices is somewhat lengthy and so the whole production line slows down just to program devices. With pre-programmed devices inserted onto the board, multiple programmers could be paralleled to keep up with the production line flow. Therefore, for production, the customer might want to consider purchasing the parts programmed from a distributor or programming them in a socket.

Fourth Flash Programming Method:

A fourth approach would be to program the flash using self programming. Two methods are available to accomplish this, but the customer is cautioned to contact Martan, if self programming is desired, in order to confirm that a particular device supports self programming. This approach is used to program the flash from either the CAN or J1850 busses. Self programming involves loading the programming software into RAM, and then the new program is programmed into flash. The SFR (Special Function Register) can be configured to recognize the hidden ROM. For self programming, the micro does not have to be reset so the reset vector does not need to be modified.

The NEC microcontrollers do not have blocks, and the flash is one entire block. The operations of the flash programmer always refer to the whole flash memory size. However, shadow RAM allows code to execute from the ROM in order to allow self reprogramming.

Note that the low cost K0S devices can be programmed off board in a programming socket and also in-circuit. The K0S devices, however, can not be self programmed through a serial port. This means the devices can be soldered down onto the user's circuit board and programmed via the header connection shown above using the Flash Pro3 programmer. They can not be programmed through a CAN or serial interface. The K0 (full 8 bit family), K4 (16 bit), and V850 (32 bit RISC) can be programmed in any of the three modes shown.

NEC Flash ROM Programming Method 4: Self Programming

Some Flash micros support (K0 & K4, but not K0s) the self flash programming capability. In this self programming mode, the application program can re-write the content of the program in the Flash memory by itself. So the flash writer is not needed.

We have 2 way for the self programming.

Method 1:

Method 2:

uPD78098x
uPD78083x
uPD78F4225

K Series

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NEC Flash ROM Programming Method 4: Self Programming

uPC29S10GR is used for generating 10V into Vpp for programming.

uPD78098x
uPD78083x
uPD78F4225

K Series

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Fifth Flash Programming Method:

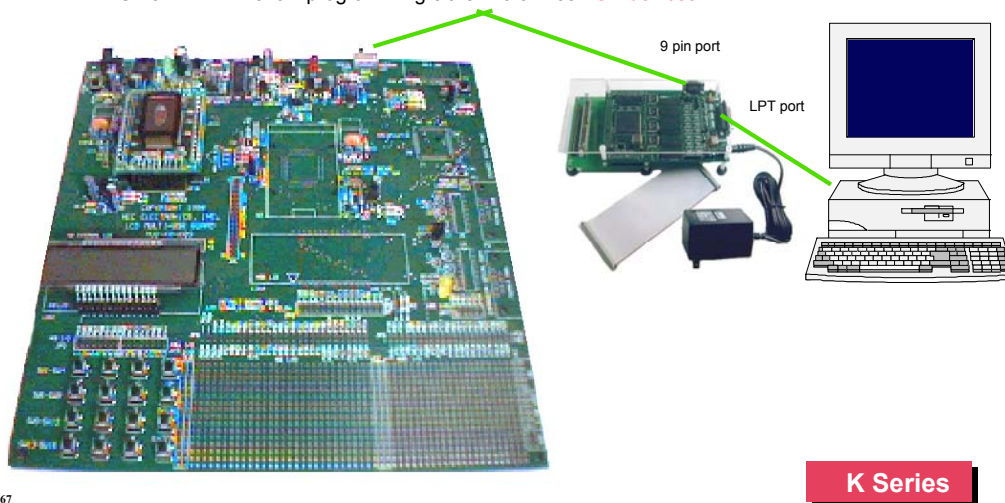
The customer can use the Multi Use Board (MUB-K0-K0S) to program the K0/K0s LCD devices. However, in this mode, the Multi Use Board really just replaces a Flash Adapter, since a Flash Pro3 or Low Cost Emulator is still required. The board is inexpensive (\$199) and if the user already has it for development work, then it probably makes sense to replace the Flash Adapter functionality with it.

NEC Flash ROM Programming Method 5: Multi Use Board

First, we need the Multi Use Board (MUB-K0-K0S).

Use the Programming Socket

RS-232 Link will allow programming either K0 or K0s LCD devices




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Sixth Flash Programming Method:

The Low Cost Emulator (LCE) can support flash programming of devices. However, the Low Cost Emulator can sometimes take up to 4 times longer to program flash devices than the FlashMaster and Flash Pro3 programmers. The main issue is that the Low Cost Emulator does not have a buffer to store the data that is being programmed in the flash device. The Low Cost Emulator should be sufficient for programming devices in the lab, but is probably not acceptable for production use. See the programming time section for more information.


Seventh Flash Programming Method:

The KOREwriter was developed as an extremely low cost flash programmer. However, the pinout connections are not compatible with the LCE, Flash Pro3, and Flash Master.



Artan, Inc.
Manufacturer's Representative

NEC Flash Programming



KOREWriter II (USB)
K0 and K0S Flash Programmer

- ❖ Low cost programmer
- ❖ USB so easy to interface to.

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Flash Adapter


The flash adapter allows the device to be programmed with the in a socket before the device is soldered down on the board. However, the user needs to be aware of some issues:

1. The Flash Adapter can not connect directly to the Flash Master because the Flash Adapter has a 9 pin connector while the Flash Master has a 15 pin connector. Therefore, an adapter cable needs to be made to use the Flash Master.
2. Flash Adapter is difficult to connect directly to the Low Cost Emulator (LCE). The Flash Adapter needs to be mounted upside down in order to properly mate to the LCE. In order to connect the two units together with-out an adapter cable, the Flash Adapter needs to be put upside down on the work surface. Otherwise, a 9 pin male to female adapter cable needs to be constructed.

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3. Wires need to be soldered onto the Flash Adapter. The Flash Adapter can not be used directly out of the box because different 44 pin package devices have different flash programming pinouts. Also, different programming modes are available and each one requires a slightly different pinout on the Flash Adapter. The flash pinouts are shown in the datasheet for each specific microcontroller.
4. Use the same basic schematic as shown for in-circuit programming. However, the CLK/X1 signal will have to be connected since the Flash Adapter does not have an on-board crystal.

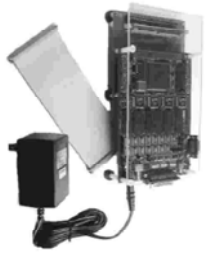
The Flash Adapter directly connects to the Low Cost Emulator only if the Flash Adapter is held in an upside down position. Therefore, the user probably will want to create an adapter cable to make this easier.

 **Artan, Inc.**
Manufacturer's Representative

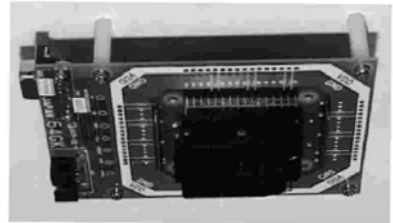
LCE + Flash Adpater

■ **Flash programming 9 pin connector**


- Does not mate with Flash Adapter
- Requires adapter cable or putting the Flash Adapter upside down




[Low Cost Emulator \(LCE\)](#)



[Flash Adapter](#)



Wiring up the Flash Adapter as shown in the datasheet

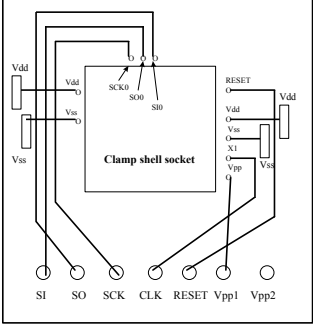


Flash Adapter


■ **Wiring is required by the customer**

- Not obvious with Japanese instructions that ship with unit
- Wire up as shown in the datasheet.
- Locate pins on the bottom of the board

FA-44GB Adapter



Existing Flash Adapter

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Note, when using the Flash Adapter, the clock source is usually provided by the programmer. Therefore, the CLK OUT signal must be routed to the X1 pin of the micro. On the connection schematics shown above, the CLK OUT / X1 signal is not shown connected because the user board usually provides this signal.

On the setup menu, be sure to select an external clock. The Flash Pro4 accomplishes this by de-selecting the “On Target (Hz)” box to signify that the clock is NOT being provided by the target board (flash adapter).

Device Security

All of the NEC K0s, K0, and K4 devices feature secure flash ROM. Once programmed, the device contents can ***not*** be read back from the device, either with a programmer nor with in-circuit programming. The contents can be compared with what is in the programmer memory, via a Program Compare instruction, but not a read of the memory contents. Even NEC factory personnel can ***not*** read back the contents of the flash ROM.

Third Party Vendor Support

NEC Electronics Inc.

Differences between the Flash Master, Flash Pro3, and Low Cost Emulator.

1. Flash Pro3 (NEC p/n = FL-PR3). Has ability to program the parts on the flash adapter (socket program then move it to the board), on board programming (generate +10V and provide proper clock and data signals), and self programming (program via the UART). All cables are supplied. ROM device is required in order to program in standalone mode. In addition, support for future devices is provided by adding a new device file rather than re-installing the complete software. Driver support at (select Flash Pro3 parameter file): <http://www.ic.nec.co.jp/micro/ods/eng> .
2. Flash Pro3 (NEC p/n = PG-FP3). Same device as the FL-PR3, but it cream colored versus the blue colored FL-PR3. Pricing is better for the FL-PR3, so customer should order that programmer.
3. Flash Pro4 (NEC p/n = PG-FP4). The programmer is similar to the Flash Pro3 but has USB host connection. PRM files, instead of PRC files, are used by this new programmer. The Flash Pro4 also supports a setup file, called a SET file, which allows the user to setup the programming voltage, clock frequency, programming source, etc, and save that configuration for every project. PRM Driver support is at: <http://www.ee.nec.de/updates> .
4. Flash Master (NEC p/n = FLASHMASTER). As it ships, it is configured only to program devices in the flash adapter (socket program then move it to the board). However, there is a connector on the unit which the customer could make a cable harness to bring out the Vpp, Vcc, Sdata, and Sclk signals for on board programming. Since this cable is not supplied and schematics are not supplied, it may take the customer some time to configure such a cable. Supports digital programming mode. Support for future devices is provided only by re-installing the complete software GUI software on the computer. Driver support is available at : http://www.nec.de/Products/Micro/Tools/Download/Flashmaster_3x/Index.html .
5. Low Cost Emulator (LCE). Current version of the LCE supports the use of Flash Pro3 device parameter files. The original LCE for the uPD78F9418A did not support device parameter files so the GUI (Graphical User Interface) software had to be reinstalled every single time. Driver support at (select Flash Pro3 parameter file) : <http://www.ic.nec.co.jp/micro/ods/eng> .
6. KOREwriter. The intent of this device was to provide a very low cost flash programmer for the NEC Design Contest. Currently, the KOREwriter only supports the uPD78F941x family of devices. Future plans might support other devices.

Therefore, if the customer desires to perform on-board programming, it might be advantageous to purchase the slightly more expensive Flash Pro4 in order to get all the necessary cables and have the unit tested and ready to perform any type of programming option.

The Flash Master ships with only one cable. This cable can be used for connecting the Flash Master to the NEC Flash Programming Adapter. However, if the user has the same 10 pin connector on their board then they can use this cable for in circuit programming, or they can make their own adapter cable. Also if they are not going to use any programmer adapter, they can cut the connector from one end of this cable to convert it to a loose wire and then use it anyway they want.

Here are a few additional vendors that have support of the NEC flash micros.

BP Microsystems
<http://www.bpmicro.com/devices>
1 800 225 2102

SMS
www.sms-sprint.com
544 Weddel Dr. Suite 12
Sunnyvale, CA 94089
Usa_service@sms-sprint.com
408 542 0388
1 800 632 2776

XELTEK
3444 De La Cruz Blvd.
Santa Clara, CA 95054
Info@xeltek.com
www.xeltek.com
(408) 588 9940

These other third party vendors support flash programming of NEC microcontrollers for certain devices. Since they have the programming algorithms already designed, it should be fairly easy for these vendors to support the particular device which the customer is trying to use. In the case of BP Microsystems, all of the I/O pins are settable and programmable. Therefore, device support requires only a software modification from BP Micro. The customer should work with these vendors in asking for particular device support.

[Programming Time](#)

Programming time depends upon how many previous times the microcontroller has been programmed, if the device is being programmed at room temperature

NEC Electronics Inc.

or a different temperature, and what programming tool is used for the operation.

However a rough rule of thumb can be used. Programming time is around 2msec per byte, which includes verification time. An erase time of 100 msec for any size of sector is a good starting reference point.

The actual programming time for virgin parts was verified on several different programming devices. The programming time was roughly 30 ~ 40 sec for the 78F0833 device under the following parameters:

1. Use Flash Pro3 programmer
2. Parts are virgin
3. Use the uPD78F0833 device
4. 3Wire SIO 1M baud rate (between programmer & Chip)
5. 4.19 MHz Crystal Speed
6. Parts are enhanced programming efficiency revision. Otherwise, programming times are about 2x.

The chart below compares the programming time of 4 currently available flash programming techniques (KOREwriter times not available).

FL-PR3 Version K12

CODE SIZE	PROGRAM (seconds)	ERASE (seconds)
16K	40	22
32K	40	22

LCE-K0S (ID78K0S-LCE v2.02)

CODE SIZE	PROGRAM (seconds)	ERASE (seconds)
16K	80	30
32K	143	30

FLASHMASTER 2.0 (GUI v2.01)

CODE SIZE	PROGRAM (seconds)	ERASE (seconds)
16K	43	9
32K	43	9

KOREwriter (GUI v)

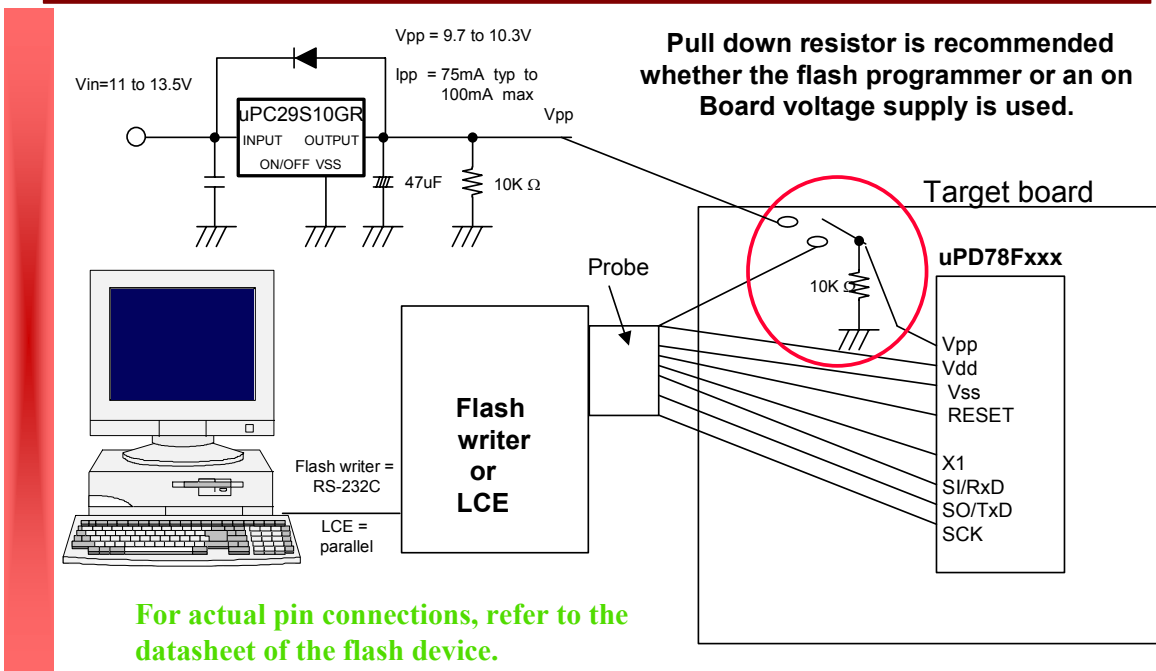
CODE SIZE	PROGRAM (seconds)	ERASE (seconds)
16K	N/A	N/A
32K	N/A	N/A

Programming Supply

It is best to ground the Vpp pin through a 10Kohm resistor, and apply the voltage

to the resistor/Vpp junction. The Vpp supply should be between 9.7V to 10.3V, with a Ipp current of 75mA typ and 100mA maximum. Refer to the datasheet for the particular device to determine what the programming voltage supply should be.

Using a pull down Vpp resistor

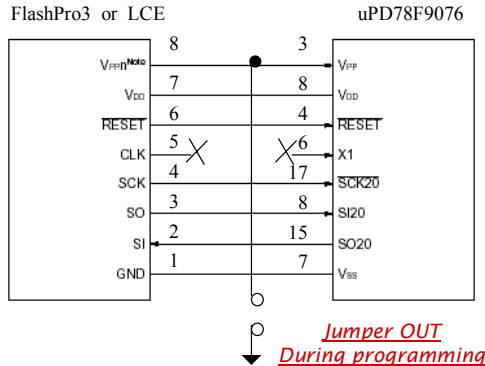


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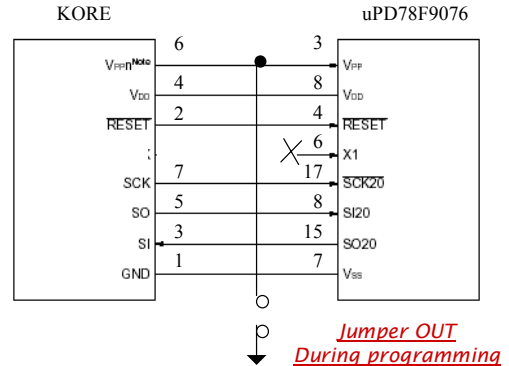
In some cases, the user might experience difficulties with programming the flash devices. The user might try to ground the Vpp pin through a jumper rather than using the 10K ohm resistor.

Flash Programming Connector

[uPD78F9076 with FlashPro3 or LCE](#)



[uPD78F9076 with KORE/Flash Pro4 header](#)



■ CLK and Vdd

- ❖ CLK signal should not be wired to the micro because it will interfere with normal operation. If CLK is used from the programmer, then jumpers should isolate the crystal from the CLK signal.
- ❖ Vdd can be specified as on board, if desired, except for the LCE which requires this signal.

[Top view of PCB connector to Mate with KORE/FP4 header](#)

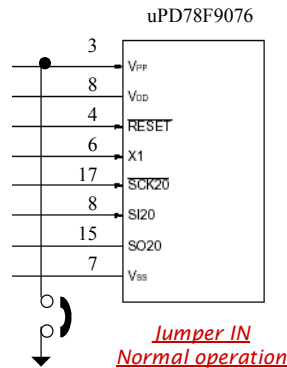
1	2
3	4
5	6
7	8
9	10

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Flash Programming Connector

[uPD78F9076 normal operation after programming](#)



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Trouble Shooting Tips

Note, updated information is available in another application notes (an_uc42.pdf), which is available on the Martan web site (<http://www.martan.com>).

- | | |
|-----|--|
| 4. | <p>Low Cost Emulator (LCE) can not communicate with the computer</p> <p>Need to set the parallel port for bi-directional communication in the BIOS setup of the computer. Also, check that power is turned on to the LCE.</p> |
| 14. | <p>Hook up of the Low Cost Emulator (LCE) to perform in-circuit flash programming</p> <p>The 9 pin flash programming connector on the Flash Pro3, Flash Writer, and Low Cost Emulator (LCE) are all identical. The connection from the 9 pin flash port to the device is shown in the datasheet for the flash device. This pin out can sometimes change from device to device, so it is best to consult the datasheet for the device actually being used.</p> |
| 16. | <p>Flash Adapter does not appear to program parts properly</p> <p>The Flash Adapter does not program devices directly out of the box. Each adapter can program a number of different flash devices, some of which have vastly different pinouts. Therefore, the Flash Adapter ships with-out any flash connection pins, and the user is required to solder connection wires to the flash pins as shown in the flash device datasheet.</p> |
| 18. | <p>“Device file not found” message when invoking LCE</p> <p>Device files need to be loaded before the LCE is initialized. This message usually occurs if no device files have been loaded into the program manager.</p> |
| 19. | <p>50 pin LCE connector does not program the flash devices properly</p> <p>The 50 pin connector on the Low Cost Emulator (LCE) that is used for in-circuit debug can NOT be used for flash programming. The 9 pin connector, although it connects to the same pins as the in-circuit emulation probe, contains extra hardware for timing and verification. Therefore, the user must program from the 9 pin connector of the LCE.</p> |
| 22. | <p><i>DLL ERROR - Error setting up flash programming; code 9: Bad PRC file on the LCE while flash programming?</i></p> <p>The new LCE supports Flash Pro3 device parameter files. These files can be downloaded off the NEC web site (see AN_uc11.pdf) for the web site address.</p> |

23. **Error calling FlashErase --**
LCEFlashErase: E302: No ACK on STATUSCommand (pw)
Error message on the LCE while flash programming?
- This error message occurs while trying to erase flash devices. Sometimes it might take 30 minutes for this message to appear. The problem is that the LCE Debugger software does not recognize certain parameters inside the Flash Parameter Files (.prc). The solution is a patch or latest version of the Debugger software.
24. **E 903 Unable to find any PRM file. Please install PRM files**
Error message on the Flash Pro4 while flash programming
- This usually happens the first time a Flash Pro4 is installed because the FP4.INI file has not been set for the Flash Pro4. This can be resolved by creating a \PRM (all capitals) directory from where the Flash Pro4 resides. Then, copy any PRM file to that new \PRM directory.
25. **Can NOT Communicate with Device**
Error message on the Flash Pro4 while flash programming
- Check the connections to the microcontroller. Check the RESET line to make sure it resets. Also, the timing constant of the RESET should probably use a capacitor value of around 0.1uF. To check if the RESET line is the problem, the capacitor on the device board can be unsoldered and the Flash Pro4 will provide the RESET signal. The RESET capacitor has to be inserted back onto the board to reset the micro.
29. **Can NOT configure LCE. Error code #7.**
- SI and SO pins need to go directly to the pins. The Flash Pro3 and Flash Pro4 have enough current output to drive the pins through current limiting resistors. The LCE does not have enough current output, so pins must be directly connected.

30. **Quick Flash Programming Troubleshooting Tips**

Some quick tips

1. SI and SO pins need to go directly to the pins. The Flash Pro3 and Flash Pro4 have enough current output to drive the pins through current limiting resistors. The LCE does not have enough current output, so pins must be directly connected without using series connected resistors.
2. Check to see that Vpp voltage is proper on the pin of the microcontroller. The LCE keeps the Vpp voltage on whenever the LED is on, until an error event is cleared by the user
3. Verify that the Vdd and Vss voltages are proper on the microcontroller. Sometimes the user board has a regulator which must be bypassed if the programmer/LCE can not supply a high enough voltage.
4. Try to have the programmer/LCE provide the Vdd voltage since having the target board provide the Vdd complicates matters.
5. If the target board is supplying the Vdd voltage, are the grounds of the target board connected to the Vdd supply and to the Vpp ground?
6. Verify that the device is oscillating by placing an oscilloscope onto the X1 pin of the microcontroller.
7. Look for activity on the SI, SO, and SCK pins.
8. Try reversing the SI and SO pins and see if that helps.

Problems with flash programming:

Some brief questions for flash programming that will help resolve these issues. These questions are intended to offer insight and are not meant to burden the customer.

1.	What device are you programming?	
2.	What Flash programmer are you using?	<input type="checkbox"/> FlashPro3 <input type="checkbox"/> FlashMaster <input type="checkbox"/> FlashPro4 <input type="checkbox"/> LCE <input type="checkbox"/> KOREwriter II
3.	What version flash device file are you using?	
4.	Is the device being programmed in circuit or with a Flash Adapter?	
5.	What circuitry is there on the Vpp pin?	
6.	What mode are you programming in?	<input type="checkbox"/> SIO0 <input type="checkbox"/> Self Programming UART
7.	What is supplying Vdd?	<input type="checkbox"/> Programmer <input type="checkbox"/> Board
8.	Have you successfully programmed this device before?	<input type="checkbox"/> Yes <input type="checkbox"/> No
9.	If YES, was the same configuration used as before?	<input type="checkbox"/> Yes <input type="checkbox"/> No
10.	Have you tried removing all external components on the flash pins (SCK, SI, SO)?	<input type="checkbox"/> Yes <input type="checkbox"/> No

Comments

Please feel free to call regarding any issues or questions about NEC flash microcontrollers. This product will offer significant advantages to the customer.

Sincerely,

Roman Budek
Field Application Engineer