NEC

User's Manual

MC-CPU-78F0714

Micro-Board for µPD78F0714 Microcontroller for use with Motor Control I/O Interface Board

Document No. U17707EU1V1UME0
Date Published August 2006

Printed in Germany

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NOTES FOR CMOS DEVICES

① VOLTAGE APPLICATION WAVEFORM AT INPUT PIN

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (MAX) and V_{IH} (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (MAX) and V_{IH} (MIN).

② HANDLING OF UNUSED INPUT PINS

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

③ PRECAUTION AGAINST ESD

A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

④ STATUS BEFORE INITIALIZATION

Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

⑤ POWER ON/OFF SEQUENCE

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

⑥ INPUT OF SIGNAL DURING POWER OFF STATE

Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements.

Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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For further information,
please contact:

NEC Electronics Corporation
1753, Shimonumabe, Nakahara-ku,
Kawasaki, Kanagawa 211-8668,
Japan
Tel: 044-435-5111
http://www.necel.com/

[America]

NEC Electronics America, Inc.
2880 Scott Blvd.
Santa Clara, CA 95050-2554, U.S.A.
Tel: 408-588-6000
800-366-9782
http://www.am.necel.com/

[Europe]

NEC Electronics (Europe) GmbH
Arcadiastrasse 10
40472 Düsseldorf, Germany
Tel: 0211-65030
http://www.eu.necel.com/

Hanover Office
Podbielskistrasse 166 B
30177 Hannover
Tel: 0 511 33 40 2-0

Munich Office
Werner-Eckert-Strasse 9
81829 München
Tel: 0 89 92 10 03-0

Stuttgart Office
Industriestrasse 3
70565 Stuttgart
Tel: 0 711 99 01 0-0

United Kingdom Branch
Cygnus House, Sunrise Parkway
Linford Wood, Milton Keynes
MK14 6NP, U.K.
Tel: 01908-691-133

Succursale Française
9, rue Paul Dautier, B.P. 52180
78142 Velizy-Villacoublay Cédex
France
Tel: 01-3067-5800

Sucursal en España
Juan Esplandiu, 15
28007 Madrid, Spain
Tel: 091-504-2787

Tyskland Filial
Täby Centrum
Entrance S (7th floor)
18322 Täby, Sweden
Tel: 08 638 72 00

Filiale Italiana
Via Fabio Filzi, 25/A
20124 Milano, Italy
Tel: 02-667541

Branch The Netherlands
Steijgerweg 6
5616 HS Eindhoven
The Netherlands
Tel: 040 265 40 10

[Asia & Oceania]

NEC Electronics (China) Co., Ltd
7th Floor, Quantum Plaza, No. 27 ZhiChunLu Haidian
District, Beijing 100083, P.R.China
Tel: 010-8235-1155
http://www.cn.necel.com/

NEC Electronics Shanghai Ltd.
Room 2509-2510, Bank of China Tower,
200 Yincheng Road Central,
Pudong New Area, Shanghai P.R. China P.C:200120
Tel: 021-5888-5400
http://www.cn.necel.com/

NEC Electronics Hong Kong Ltd.
12/F., Cityplaza 4,
12 Taikoo Wan Road, Hong Kong
Tel: 2886-9318
http://www.hk.necel.com/

Seoul Branch
11F., Samik Lavied'or Bldg., 720-2,
Yeoksam-Dong, Kangnam-Ku,
Seoul, 135-080, Korea
Tel: 02-558-3737

NEC Electronics Taiwan Ltd.
7F, No. 363 Fu Shing North Road
Taipei, Taiwan, R. O. C.
Tel: 02-8175-9600
http://www.tw.necel.com/

NEC Electronics Singapore Pte. Ltd.
238A Thomson Road,
#12-08 Novena Square,
Singapore 307684
Tel: 6253-8311
http://www.sg.necel.com/

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[MEMO]

Preface

Readers

This manual is intented for users who want to understand the functions of the MC-CPU-78F0714 Micro-Board for µPD78F0714 Microcontroller for use with Motor Control I/O Interface Board.

Purpose

This manual presents the hardware manual of the MC-CPU-78F0714 Micro-Board for µPD78F0714 Microcontroller for use with Motor Control I/O Interface Board.

Organization

This system specification describes the following sections:

- System specifications
- Hardware features
- On-board components

Legend

Symbols and notation are used as follows:

Weight in data notation	:	Left is high-order column, right is low order column
Active low notation	:	$\overline{xxx}$ (pin or signal name is over-scored) or /xxx (slash before signal name)
Memory map address:	:	High order at high stage and low order at low stage
Note	:	Explanation of (Note) in the text
Caution	:	Item deserving extra attention
Remark	:	Supplementary explanation to the text
Numeric notation	:	Binary... xxxx or xxxB Decimal... xxxx Hexadecimal... xxxxH or 0x xxxx

Prefixes representing powers of 2 (address space, memory capacity)

K (kilo): $2^{10} = 1024$

M (mega): $2^{20} = 1024^2 = 1,048,576$

G (giga): $2^{30} = 1024^3 = 1,073,741,824$

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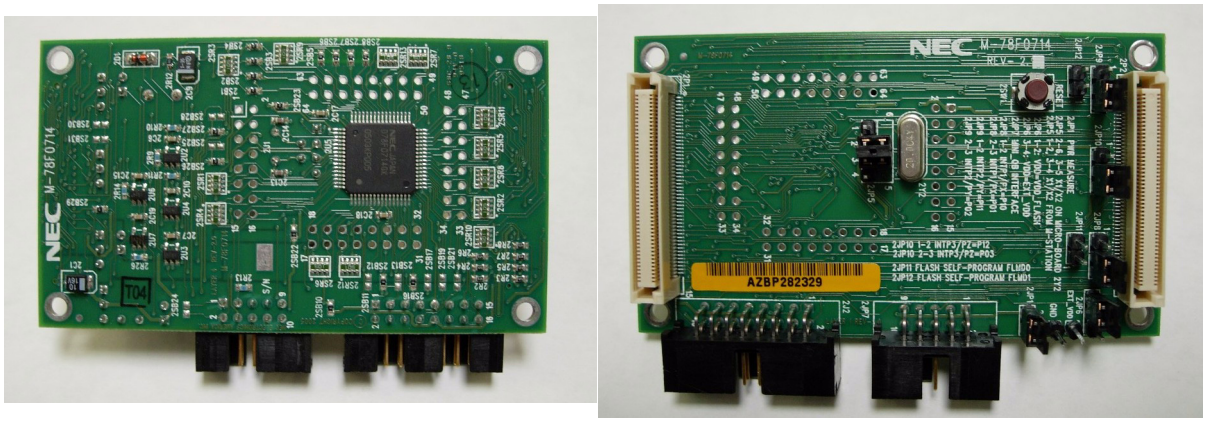
Chapter 1 Introduction

The MC-CPU-78F0714 micro-board is designed to demonstrate and evaluate the CPU and on-chip peripheral functions of the NEC Electronics 8-bit μPD78F0714 microcontroller (MCU). The micro-board can be operated in stand-alone mode to evaluate the main features of the MCU or it can be connected through two 100-pin connectors to a separately sold motor control interface board (MC-IO) to evaluate the MCU's dedicated 3-phase motor control peripherals. The micro-board also may be used with a low-cost evaluation system called the *M-Station* (sold in the U.S. only), but this manual only describes configuration and operation of the MC-CPU-78F0714 when used with the MC-IO board.

Figure 1-1: MC-CPU-78F0714 Micro-Board

Top View **Bottom View**



Chapter 2 System Specifications

2.1 Specifications of the µPD78F0714 Microcontroller

- Flash program memory of 32 KB
- High-speed data RAM of 1 KB
- Forty-eight I/O ports: 40 CMOS input/output (I/O) pins and eight CMOS inputs
- Eight-channel, 10-bit analog-to-digital (A/D) converter
- Serial interfaces
  - One-channel universal asynchronous receiver/transmitter (UART)
  - One-channel, 3-wire serial I/O
- Timers
  - One-channel, 10-bit inverter control timer
  - One-channel, 16-bit up/down counter for motor encoder interfacing
  - One-channel, 16-bit timer/event counter
  - One-channel, 8-bit timer/event counter
  - Two-channel, 8-bit timer
  - One-channel watchdog timer
- Eleven timer outputs (with six inverter control outputs for motor driving)
- Twenty vectored interrupts
- Eight external interrupts
- 4.0–5.5 V_{DC} power supply voltage
- 64-pin, 12 × 12 mm TQFP (µPD78F0714GK-9ET)
- Reference: *µPD78F0714 User's Manual* (U16928EJ1V0UD00)

2.2 Specifications of the MC-CPU-78F0714 Micro-Board

- On-board 20 MHz main clock
- MCU I/O port connector that provides all I/O pins of the µPD78F0714
- 16-pin debugging and flash programming interface connector
- 10-pin QB-78K0MINI on-chip debugging interface connector
- Board size of 3.5 × 2 inches (W × L)

Chapter 3 Hardware Features

Figure 3-1: MC-CPU-78F0714 Micro-Board Layout

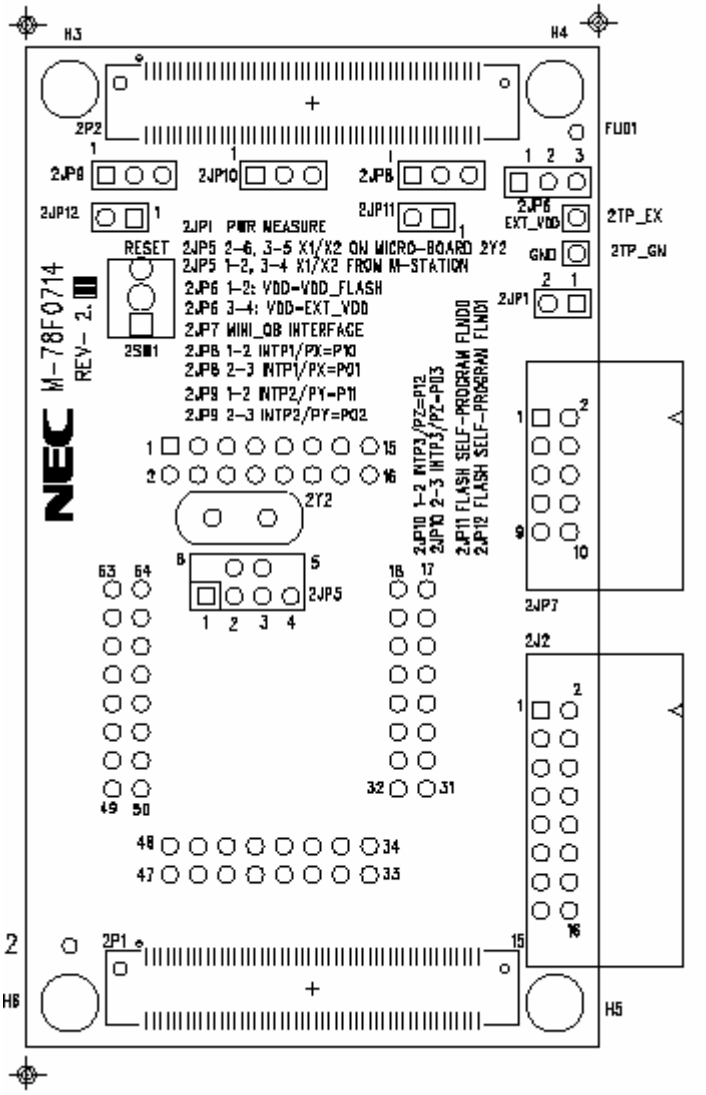


Table 3-1: Default Jumper Settings

Jumper	Setting	Function	Description
2JP1	1–2	VDD_KX-VDD	µD78F0714 V_{DD} is derived from VDD_KX
2JP5	2–6 3–5	X1/X2 select Must be selected as a pair	Selects X1 and X2 from on-board oscillator
2JP6	2–3	VDD_KX – 2TPEXTVDD1	Supplies external VDD
2JP8	2–3	INTP1_PX to P01	Sensor input to P01/INTP1
2JP9	2–3	INTP2_PY to P02	Sensor input to P02/INTP2
2JP10	2–3	INTP3_PZ to P03	Sensor input to P03/INTP3
2JP7	Open		
2JP11	Open		
2JP12	Open		

3.1 Operating Modes

3.1.1 Demonstration configuration

In standalone mode, the MC-CPU-78F0714 micro-board can be used to execute programs loaded into the MCU's on-chip flash memory for the purpose of evaluating the CPU and its on-chip peripheral functions. To configure for standalone operation, attach the MC-CPU-78F0714 micro-board to the MC-IO board through the two 100-pin connectors. By default, the MC-CPU-78F0714 micro-board is configured to operate in this mode, as shown in Default Jumper Settings .

3.1.2 Debugging configuration

To debug a user program, connect the MC-CPU-78F0714 micro-board to the separately sold 78K0MINI in-circuit emulator (ICE) using the 2JP7 on-chip debugging connector. In debugging mode, the 78K0MINI ICE supplies the clock to the CPU through that connector. Also disconnect the on-board, 20-MHz crystal oscillator by removing the jumpers on the 2JP5 headers.

Alternatively the MC-CPU-78F0714 board can be debugged using the 78K0 IECUBE full-function ICE. Contact your NEC Electronics representative for additional information.

3.2 Power Supply

When pins 1 and 2 of 2JP6 are connected, the MC-IO board supplies $5V_{DC}$ to the MC-CPU-78F0714 micro-board through the two 100-pin connectors.

To use an external power source, connect pins 2 and 3 of 2JP6 with a jumper block and connect the power source ($5V_{DC}$ max.) to 2TP_EXTVDD1 and 2TP_GND1.

3.3 Reprogramming the MCU's Flash Memory

The on-chip flash memory can be reprogrammed at any time. To reprogram the on-chip flash memory, a dedicated flash programmer such as the PG-FP4-E (sold separately) can be used when connected to 2J2 16-pin header terminal. When the 78K0MINI ICE is used for debugging and the code is downloaded, the flash memory will retain the program.

3.4 Measuring Power Consumption of the µPD78F0714

The power select jumper, 2JP1, is designed to connect an ampere meter to measure accurate power consumption for the µPD78F0714, regardless of which power source is selected. To measure power consumption for the µPD78F0714:

1. Remove the power select jumper on 2JP1.
2. Connect an ampere meter on the 2JP1 terminals.

Table 3-2: 2JP1: Current Measurement Terminal

Setting	Selected Power Source	Status
1 to 2	Connect with jumper: VDD_KX to VDD	Default
1 to 2	Connect with ampere meter: CPU current measurement	

Caution: 2JP1 is a dedicated terminal connected to the V_{DD} pin of the µPD78F0714 so that MCU power consumption can be measured accurately. Therefore, the MC-CPU-78F0714 micro-board can remain connected to the MC-IO board during power measurement.

Chapter 4 On-Board Components

4.1 2J2: 16-Pin Flash Programming Interface Header

The 16-pin header provides flash programming Interface for the MC-CPU-78F0714. To program the flash, the NEC Electronics flash programmer such as the PG-FP4-E can be used. For instructions on how to program the flash, refer to the *PG-FP4-E User's Manual*.

Note: The 16-pin flash programming interface header can also be used for debugging the program running on the MC-CPU-78F0714 using the M-Station *that is sold in the U.S. only*. Some of the pin names shown in Figure 2 are dedicated for the M-Station interface. This manual only lists the interface signals for the PG-FP4-E flash programmer.

Figure 4-1: Signal Assignments for 16-Pin Debugging and Flash Programming Interface Connector

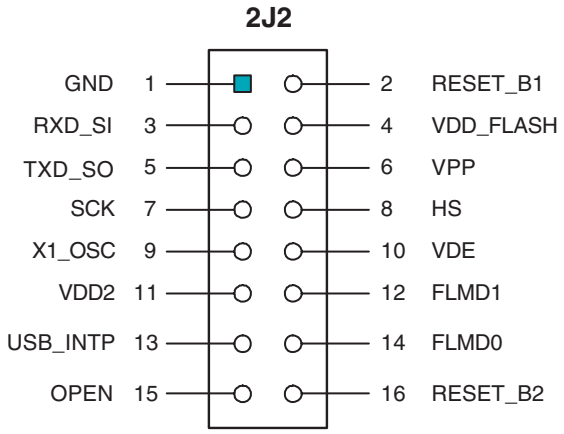


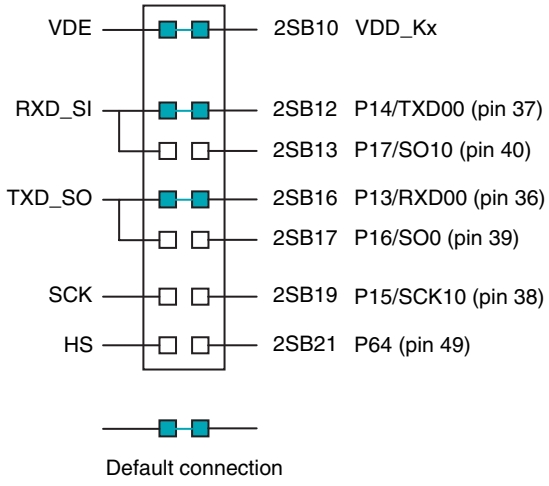
Table 4-1: Flash Programming Signal Descriptions

Pin No.	MC-CPU-78F0714	PG-FP4-E Flash Programmer
1	GND	GND
2	RESET_B1	Reset to MC-CPU-78F0714
3	RXD_SI	Serial I/O or UART data receive
4	VDD_FLASH	VDD from Flash programmer
5	TXD_SO	Serial I/O or UART data transmit
6	VPP	Not Used
7	SCK	SCK
8	HS	Handshake
9	X1_OSC	Clock to MC-CPU-78F0714
10	VDE	VDD
11	VDD2	Not Used
12	FLMD1	Not Used
13	USB_INTP	Not Used
14	FLMD0	FLMD0
15	OPEN	
16	RESET_B2	Not Used

4.2 SBx Array: Flash Interface Signal Selection

The SBx array (solder blobs) is used to connect the flash programming interface signals on the 16-pin 2J2 header to appropriate pins of the µPD78F0714. The default settings shown in SBx Array are configured for flash programming.

Figure 4-2: SBx Array



4.3 2JP6: VDD_KX Selection

The MC-CPU-78F0714 micro board can derive power from two sources: EXT_VDD, a user-supplied external power source between 4.0–5.5 V_{DC} or VDD_FLASH, a power source derived from the MC-IO board's two 100-pin connectors, 2P1 and 2P2.

Figure 4-3: 2JP6 Configuration

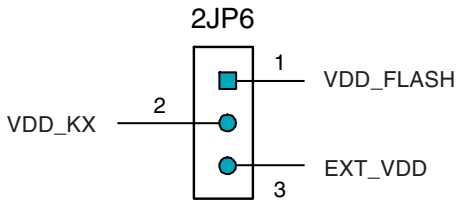


Table 4-2: 2JP6 Settings

Setting	Selected Power Source	Status
1 to 2	Select VDD_FLASH from MC-IO board	Default
2 to 3	Select EXT_VDD from user's target system	

4.4 2JP5: Main Clock Selection Jumper

A 20 MHz crystal oscillator (2Y2) is mounted on the MC-CPU-78F0714 micro-board as the main clock. If desired, it can be removed and replaced by a different model. A Citizen HC49US Series quartz crystal oscillator that uses 18-picofarad (pF) biasing capacitors for a range of frequencies is recommended.

The X1 and X2 pins of the µPD78F0714 are also connected to the I/O pin array, and may be driven by external connection to the appropriate pins of the I/O pin array. In this case, all pins of 2JP5 should be left open.

The 2JP5 should be left open when using the 10-pin connector, 2JP7, connecting to the on-chip debugging emulator, such as QB-78K0MINI.

Figure 4-4: 2JP5 Jumper

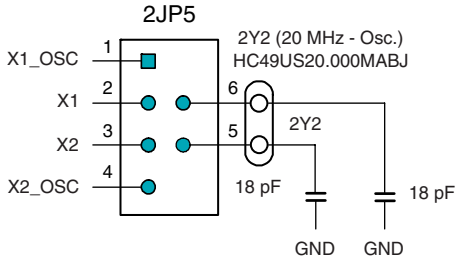


Table 4-3: 2JP5 Settings

Setting	Selected Main Clock Source	X1 Clock	Status
2 to 6 3 to 5	Select X2 from MC-CPU-78F0714 micro-board	X1 = 20 MHz Must be selected as a pair	Default
	Select X1 from MC-CPU-78F0714 micro-board		
1 to 2	Select X1_OSC from MC-IO board	**Note**	
Open	When using OCD connector 2JP7		
Open	When using clock from 2J1on the target system		

Note: For a driven clock, X1_OSC (X1_OSC from the MC-IO board connector 2P1) can be connected to X1 by inserting a jumper on pin 1 to pin 2 while X2_OSC is open. Refer to the *µPD78F0714 User's Manual* for information about configuring a driven clock for X1 and X2.

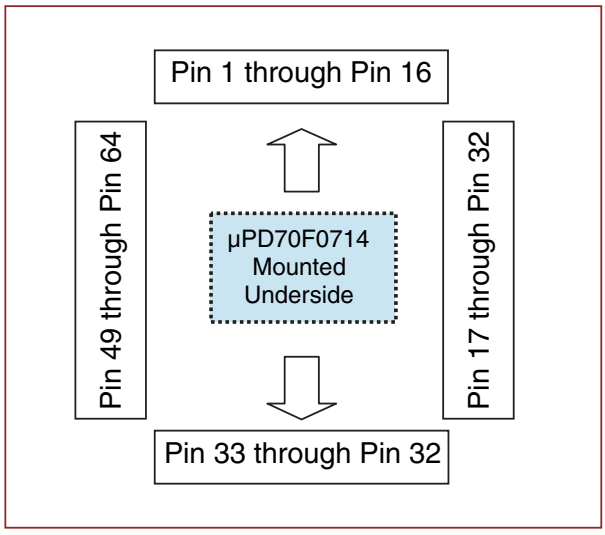
4.5 Subclock Selection

The subclock is not supported for the µPD78F0714.

4.6 1J1: µPD78F0714 I/O Pin Array

1J1 is a pin array connecting the µPD78F0714 I/O pins. It is an optional array for mounting the micro-board directly onto your target system, or for allowing easy access to all I/O pins. 1J1 is divided into four groups of 16 pins around the MCU.

Figure 4-5: I/O Pin Array



4.7 2SW1 Push Button Switch

2SW1 is a push button switch. Pressing 2SW1 connects the MCU's RESET pin to GND and resets the MCU.

4.8 2JP11: FLMD0 Connection for Flash Self-Programming Mode

Setting	Selected Power Source	Status
1 to 2	Open: normal operation	Default
1 to 2	Connect: P10 is used to drive FLMD0 for flash programming mode	

4.9 2JP12: FLMD01 Connection for Flash Self-Programming Mode

Setting	Selected Power Source	Status
1 to 2	Open: normal operation	Default
1 to 2	Connect: P11 is used to drive FLMD1 for flash programming mode	

4.10 Solder Blob Selection

Several signals of the µPD78F0714 are connected to a *solder blob*, designated as SB× on the micro-board. The solder blob is formed with two pads, making it easier to connect or disconnect with a blob of solder.

Figure 4-6: Solder Blob Pads

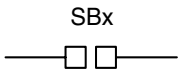


Table 4-4: SBx Connections

Connector	Description	Default
2SB1–2SB8	Optional connection for P2[7:0] termination with 1MΩ to GND	Connected
2SB22	Optional connection for EVDD to VDD	Connected
2SB23	Optional connection for AVREF to VDD	Connected
2SB10	Optional connection for VDE to VDD_KX	Connected
2SB11	Optional connection for host computer interrupt to P00/INTP0	Open
2SB12	Optional connection for RXD_SI to P14/TXD00	Connected
2SB13	Optional connection for RXD_SI to P17/SO10	Open
2SB16	Optional connection for TXD_SO to P13/RXD00	Connected
2SB17	Optional connection for TXD_SO to P16/SI10	Open
2SB19	Optional connection for SCK to P15/SCK10_B	Open
2SB21	Optional connection for HS (handshake) to P64	Open
2SB24	Optional connection for RESET_QB to RESET_KX	Open (note 1)
2SB25	Optional connection for X2_QB to P32	Open (note 2)
2SB26	Optional connection for X2_QB to X2	Connected (note 2)
2SB27	Optional connection for X1_QB to X1	Connected (note 3)
2SB28	Optional connection for X1_QB to P31	Open (note 3)
2SB29	Optional connection for INTP1_PX for speed measure	Connected (note 4)
2SB30	Optional connection for INTP2_PY for speed measure	Open (note 4)
2SB31	Optional connection for INTP3_PZ for speed measure	Open (note 4)

Notes: 1. SBx optional connections when using QB-78K0MINI ICE
(refer to document no. U17029EJ2V0UM00)
- When QB-78K0MINI is used, the QB-78K0MINI in-circuit emulator (ICE) handles the RESET connection.
- When QB-78K0MINI is not used, connect 2JP7.1 to 2JP7.2 (10-pin header) with a shorting jumper.
- 22SB24 can be used to permanently connect RESETB_KX to RESETB_QB.

2. X2_QB: X2_QB is a single-wire, bi-directional data input that can be X2 or P32
(refer to the *QB-78K0MINI User's Manual*).
- 2SB25 connects X2_QB to P32.
- 2SB26 connects X2_QB to X2 (factory default).

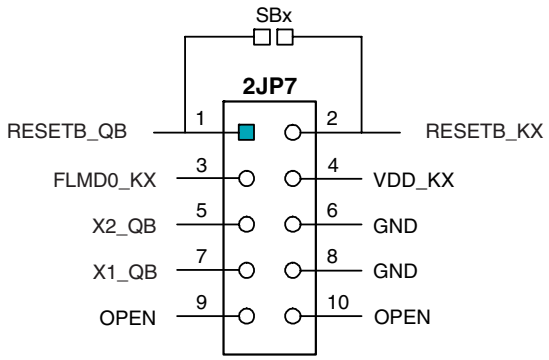
3. X1_QB: X1_QB can be X1 or P31.
- 2SB27 connects X1_QB to X1.
- 2SB28 connects X1_QB to P31.

4. Motor speed measurement input
- INTP1_PX, INTP2_PY or INTP3_PZ are signals from motor control I/O board.
- These are the signals providing sensor (HALL or back-EMF detection) inputs.
- The selected INTP_x signal is input to P53/TI000 (capture/compare register) of the on-chip timer for speed measurement.

4.11 2JP7: QB-78K0MINI ICE Connector

2JP7 is provided for connection to the QB-78K0MINI ICE. When QB-78K0MINI is connected, the MINICUBE controls the MCU's RESET line. When QB-78K0MINI is not connected, pins 1 and 2 of 2JP7 should be shorted to control the RESET from the on-board 2SW1 push button or the MC-IO board's push button through the 100-pin 2P2 target connector. To connect pins 1 and 2 on 2JP7, it is recommended to use a jumper block instead of SBx.

Figure 4-7: Micro-Board Connection to the MINICUBE



4.12 2P1 and 2P2: 100-Pin Connectors

Two 100-pin connectors are used to connect all µPD78F0714 signals to the MC-IO board. The µPD78F0714 signals are arranged so that selected signals connect to the motor control function signals on the MC-IO board, while the others can be used for prototyping. All signals are connected to pre-assigned positions of the 2P1 and 2P2 connectors.

The mating connector for the 100-pin connectors is a 0.6-millimeter (mm), single-row surface-mount technology type (Hirose FX8-Series, part number FX8C-100P-SV6).

Tables 8 and 9 show the pin assignments of the MCU to the 100-pin 2P1 and 2P2 connectors that correspond to the MC-IO board's 100-pin J1 and J2 connectors.

Table 4-5: 2P1 Connector Pin Assignments (1/3)

MC-78F0714 Micro-Board			MC-IO Board		Motor Control Function
2P1 Pin Number	Pin Name	CPU Pin Number	J1 Pin Number	Pin Name	
1			1	GND_IS	CPU ground
2			2	GND_IS	CPU ground
3	P13/RXD00	36	3	RS232_RXD	RS232 transceiver TXD output
4	P10	33	4	RS232_CTS	RS232 transceiver CTS output
5	P14/TXD00	37	5	RS232_TXD	RS232 transceiver RXD input
6	P11	34	6	RS232_RTS	RS232 transceiver RTS output
7	P64	49	7	J1007	N/A
8	P65	50	8	J1008	N/A
9	P27/ANI7	57	9	J1009	Power Module temperature
10			10	J1010	
11	P00/INTP0/TW0TOFFP	12	11	P00_ITRIP	Over- current detection
12	P01/INTP1	11	12	J1012	Hall1/BEMF1 detect (from 2JP8)
13	P02/INTP2	10	13	J1013	Hall2/BEMF detect (from 2JP9)
14	P03/INTP3	9	14	J1014	Hall3/BEMF detect (from 2JP10)
15			15	J1015	
16			16	J1016	
17			17	J1017	
18			18	J1018	
19	P20/ANI0	64	19	J1019	Phase-U current
20	P21/ANI1	63	20	J1020	Phase-V current
21	P22/ANI2	62	21	J1021	Phase-W current
22	P23/ANI3	61	22	J1022	Motor temperature
23	P24/ANI4	60	23	J1023	Speed potentiometer
24	P25/ANI5	59	24	ANI5_ISHUNT	Common current shunt
25	P26/ANI6	58	25	J1025	Spare analogue
26	P27/ANI7	57	26	J1026	Power module temperature
27	P50	17	27	J1027	N/A
28	P51	18	28	J1028	N/A
29	P52/INTP4	19	29	J1029	N/A
30	P53/INTP5	20	30	J1030	N/A
31	P54	21	31	P54_TRIPB	Power module shut-down
32	P55/INTP6	22	32	J1032	N/A
33	P56/INTP7	23	33	J1033	N/A
34	P57	24	34	J1034	N/A
35	P40	41	35	J1035	N/A
36	P41	42	36	J1036	N/A
37	P42	43	37	J1037	N/A
38	P43	44	38	J1038	N/A

Table 4-5: 2P1 Connector Pin Assignments (2/3)

MC-78F0714 Micro-Board			MC-IO Board		Motor Control Function
2P1 Pin Number	Pin Name	CPU Pin Number	J1 Pin Number	Pin Name	
39	P44	45	39	J1039	N/A
40	P45	46	40	J1040	N/A
41	P46	47	41	J1041	N/A
42	P47	48	42	J1042	N/A
43	P10	33	43	J1043	N/A
44	P11	34	44	J1044	N/A
45	P12	35	45	J1045	N/A
46	P13/RXD00	36	46	J1046	N/A
47	P14/TXD00	37	47	J1047	N/A
48	P15/SCK10_B	38	48	J1048	N/A
49	P16/SI10	39	49	J1049	N/A
50	P17/FLMD1	40	50	J1050	N/A
51			51	J1.051	
52			52	J1.052	
53			53	J1.053	
54			54	J1.054	
55	P30/BUZZ	13	55	J1.055	N/A
56	P31/PCL	14	56	J1.056	N/A
57	P32	15	57	J1.057	N/A
58	P33	16	58	J1.058	N/A
59	P70	53	59	J1059	MODE push button
60	P71	54	60	J1060	REVERSE push button
61	P72	55	61	J1061	FORWARD push -button
62	P73	56	62	J1062	START/STOP push button
63			63	J1063	
64			64	J1064	
65			65	J1065	
66			66	J1066	
67			67	J1067	
68			68	J1068	
69			69	J1069	
70			70	J1070	
71			71	J1071	
72			72	J1072	
73			73	J1073	
74			74	J1074	
75	Not used		75		
76	Not used		76		
77	Not used		77		
78	Not used		78		

Table 4-5: 2P1 Connector Pin Assignments (3/3)

MC-78F0714 Micro-Board			MC-IO Board		Motor Control Function
2P1 Pin Number	Pin Name	CPU Pin Number	J1 Pin Number	Pin Name	
79	Not used		79		
80	Not used		80		
81	Not used		81		
82	Not used		82		
83	Not used		83		
84	Not used		84		
85	Not used		85		
86	Not used		86		
87	Not used		87		
88	Not used		88		
89	Not used		89		
90	Not used		90		
91	Not used		91		
92	Not used		92		
93	Not used		93		
94	Not used		94		
95	Not used		95		
96	Not used		96		
97	Not used		97		
98	Not used		98		
99	VDD_FLASH		99	VCC_IS	Flash programmer VDD
100	DD_FLASH		100	VCC_IS	Flash programmer VDD

Table 4-6: J2 Connector Assignments (1/3)

MC-78F0714			MC-IO Board		
2P2 Pin Number	Pin Name	CPU Pin Number	J2 Pin Number	Pin Name	Function
1			1	GND_IS	CPU ground
2			2	GND_IS	CPU ground
3			3	J2003	
4			4	J2004	
5			5	J2005	
6			6	J2006	
7	P66	51	7	J2007	N/A
8	P67	52	8	J2008	N/A
9	P26/ANI6	58	9	J2009	Spare analog
10			10	J2010	
11			11	J2011	
12			12	J2012	
13			13	J2013	
14			14	J2014	
15	P64	49	15	LED0	I/O board: LED data latch 0
16	P65	50	16	LED1	I/O board: LED data latch 1
17	P66	51	17	LED2	I/O board: LED data latch 2
18	P67	52	18	LED3	I/O board: LED data latch 3
19	P40/RTP00	41	19	LED_A	I/O board: LED segment A
20	P41/RTP01	42	20	LED_B	I/O board: LED segment B
21	P42/RTP02	43	21	LED_C	I/O board: LED segment C
22	P43/RTP03	44	22	LED_D	I/O board: LED segment D
23	P44/RTP04	45	23	LED_E	I/O board: LED segment E
24	P45/RTP05	46	24	LED_F	I/O board: LED segment F
25	P46/RTP06	47	25	LED_G	I/O board: LED segment G
26	P47/RTP07	48	26	LED_DP	I/O board: LED decimal point
27			27	GND_IS	CPU ground
28			28	GND_IS	CPU ground
29	TW0TO0/RTP10	27	29	PWM_0	Phase U high
30	TW0TO1/RTP11	28	30	PWM_1	Phase U low
31			31	GND_IS	CPU ground
32			32	GND_IS	CPU ground
33	TW0TO2/RTP12	29	33	PWM_2	Phase V high
34	TW0TO3/RTP13	30	34	PWM_3	Phase V low
35			35	GND_IS	CPU ground
36			36	GND_IS	CPU ground
37	TW0TO4/RTP14	31	37	PWM_4	Phase W high
38	TW0TO5/RTP15	32	38	PWM_5	Phase W low

Table 4-6: J2 Connector Assignments (2/3)

MC-78F0714			MC-IO Board		
2P2 Pin Number	Pin Name	CPU Pin Number	J2 Pin Number	Pin Name	Function
39			39	GND_IS	CPU ground
40			40	GND_IS	CPU ground
41	P53/INTP5/TI000	20	41	SPD_MSR	Speed measurement
42			42	GND_IS	CPU ground
43	P26/ANI6	58	43	J2043	Spare analog
44	P27/ANI7	57	44	ANI7_TMP	Motor temperature
45			45	GND_IS	CPU ground
46			46	GND_IS	CPU ground
47			47	INTP1_PX	To Hall1/BEMF1 selector (2JP8)
48			48	INTP2_PY	To Hall2/BEMF2 selector (2JP9)
49			49	GND_IS	CPU ground
50			50	GND_IS	CPU ground
51			51	INTP3_PZ	To Hall3/BEMF3 selector (2JP10)
52	P20/ANI0	64	52	ANI0_IU	Phase U current
53			53	GND_IS	CPU ground
54			54	GND_IS	CPU ground
55	P21/ANI1	63	55	ANI1_IV	Phase V current
56	P22/ANI2	62	56	ANI2_IW	Phase W current
57			57	GND_IS	CPU ground
58			58	GND_IS	CPU ground
59	P23/ANI3	61	59	ANI3_TEMP	Power module temperature
60	P55/INTP6/TIT20IUD	22	60	PX_ENCA	REVERSE push button
61			61	GND_IS	CPU ground
62			62	GND_IS	CPU ground
63	P56/INTP7/TIT20CUD/ TITCC0	23	63	PX_ENCB	Motor shaft encoder
64	P57/TIT20CLR/TIT20CC1	24	64	PX_ENCZ	Motor shaft encoder
65			65	GND_IS	CPU ground
66			66	GND_IS	CPU ground
67	P73	56	67	PX_START	START/STOP push button
68	P72	55	68	PX_FORWARD	FORWARD push button
69			69	GND_IS	CPU ground
70			70	GND_IS	CPU ground
71	P71	54	71	PX_REVERSE	REVERSE push button
72	P70	53	72	PX_MODE	MODE push button
73			73	GND_IS	CPU ground
74			74	GND_IS	CPU ground
75			75	ANI4	Speed potentiometer
76			76	GND_IS	CPU ground

Table 4-6: J2 Connector Assignments (3/3)

MC-78F0714			MC-IO Board		
2P2 Pin Number	Pin Name	CPU Pin Number	J2 Pin Number	Pin Name	Function
77			77	GND_IS	
78			78	J2078	
79	VDD	4	79	VDD_KX	External CPU VDD
80	EVDD	26	80	VDD1	CPU EVDD
81			81	J2081	
82	AVREF	1	82	AVREF	CPU AVREF
83			83	AVDD	CPU AVDD
84			84	J2084	
85	RESET_B	8	85	TG_RST	CPU reset
86	FLMD0	3	86	VPP_FLMD0	CPU FLMD0
87			87	J2087	
88	X2	7	88	X2	CPU X2
89	X1	6	89	X1	CPU X1
90			90	J2090	
91			91	J2091	
92			92	J2092	
93			93	J2093	
94			94	J2094	
95			95	J2095	
96			96	J2096	
97			97	J2097	
98			98	J2098	
99			99	VCC_IS	Non-isolated power (+5V DC)
100			100	VCC_IS	Non-isolated power (+5V DC)