

## dsPIC33CK64MP105 Motor Control Plug-In Module (PIM) Information Sheet for External Op Amp Configuration

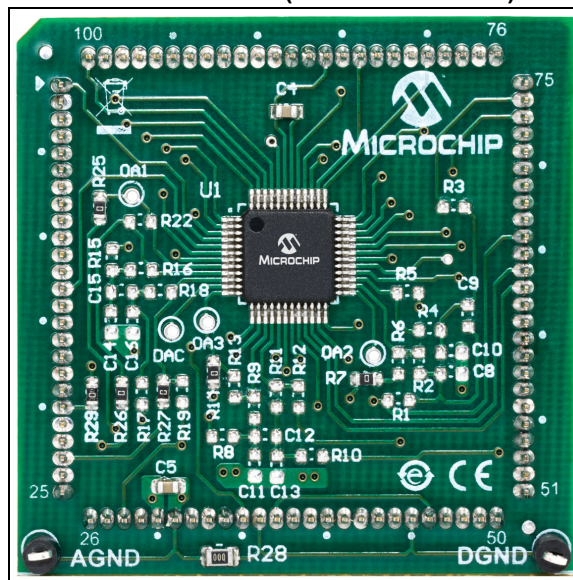
The dsPIC33CK64MP105 Motor Control PIM for External Op Amp Configuration (P/N: MA330050-1) is designed to demonstrate the motor control capabilities of the dsPIC33CK64MP105 device using external on-board op amps.

The dsPIC33CK64MP105 device is a high-performance, 16-bit Digital Signal Controller (DSC). This Motor Control PIM is designed to take advantage of the high-resolution PWM (with fine edge placement) peripheral on the device. The PWM, along with other peripherals, such as the ADC, enable motor control applications.

The PIM can be used to demonstrate and develop motor control applications by inserting it in the 100-pin PIM interface header provided on the compatible motor control development boards (see [Table 1](#)). The PIM is designed to run a single motor with all the compatible development boards. When operating this PIM on the dsPICDEM™ MCLV-2 Development Board, insert an external op amp configuration matrix board (see [Figure 2](#)) on the J14 header provided on the board. In the case of dsPICDEM MCHV-2/MCHV-3 Development Boards, insert an external op amp configuration matrix board on to the J4 header (as shown in [Figure 2](#)) on the board. This PIM can be used on the dsPICDEM MCHV-3 Development Board to implement and demonstrate single-stage boost Power Factor Correction (PFC) control, along with field-oriented control. The PIM design also enables stepper motor control using the dsPICDEM MCSM Development Board (DV330022).

For additional information regarding development boards, refer to the respective user's guides available on the Microchip website ([www.microchip.com](http://www.microchip.com)).

**FIGURE 1: dsPIC33CK64MP105 MOTOR CONTROL PIM FOR EXTERNAL OP AMP (P/N: MA330050-1)**



[Table 1](#) provides information on the hardware versions of the motor control boards that are compatible with this PIM. Refer to the specific motor control board user's guide for the hardware version identification information.

**FIGURE 2: EXTERNAL OP AMP CONFIGURATION BOARD**



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**TABLE 1: HARDWARE COMPATIBILITY**

| Development Board                            | Part Number | Compatible Hardware Version(s) |
|--|-------------|--------------------------------|
| dsPICDEM™ MCHV Development Board             | DM330023    | Not Compatible                 |
| dsPICDEM MCLV Development Board              | DM330021    | Not Compatible                 |
| Low-Voltage Motor Control Development Bundle | DV330100    | Not Compatible                 |
| dsPICDEM MCLV-2 Development Board            | DM330021-2  | All Revisions                  |
| dsPICDEM MCHV-2 Development Board            | DM330023-2  | All Revisions                  |
| dsPICDEM MCHV-3 Development Board            | DM330023-3  | All Revisions                  |
| dsPICDEM MCSM Development Board              | DM330022    | All Revisions                  |

## WARNING

**Do not connect non-isolated oscilloscope probes to the test points on the PIM while in use with the dsPICDEM™ MCHV-2 or MCHV-3 Development Board. Failure to heed this warning could result in hardware damage.**

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Table 2 provides mapping between the 48-pin device and the 100-pin PIM.

**TABLE 2: DEVICE TO PIM MAPPING (SORTED BY DEVICE PIN NUMBER)**

| Device Pin # | PIM Pin #                                 | dsPIC33CK64MP105 Device Functional Description      | Remarks                      |
|--------------|---|---|------------------------------|
| 1            | PIM:94                                    | RP46/PWM1H/RB14                                     | Direct Connection            |
| 2            | PIM:93                                    | RP47/PWM1L/RB15                                     | Direct Connection            |
| 3            | PIM:60                                    | RP60/RC12   | Direct Connection            |
| 4            | PIM:01                                    | RP61/RC13   | Direct Connection            |
| 5            | PIM:13                                    | MCLR  | Direct Connection            |
| 6            | PIM:78                                    | ANN2/RP77/RD13                                      | Direct Connection            |
| 7            | PIM:35                                    | AN12/ANN0/RP48/RC0                                  | Direct Connection            |
| 8            | PIM:25 <sup>(1)</sup>                     | OA1OUT/AN0/CMP1A/IBIAS0/RA0                         | Connected via 0 Ohm Resistor |
| 9            | PIM:24 <sup>(1)</sup>                     | OA1IN-/ANA1/RA1                                     | Connected via 0 Ohm Resistor |
| 10           | PIM:23 <sup>(1)</sup>                     | OA1IN+/AN9/RA2                                      | Connected via 0 Ohm Resistor |
| 11           | PIM:20 <sup>(1)</sup>                     | DACOUT/AN3/CMP1C/RA3                                | Connected via 0 Ohm Resistor |
| 12           | PIM:21 <sup>(1)</sup>                     | OA3OUT/AN4/CMP3B/IBIAS3/RA4                         | Connected via 0 Ohm Resistor |
| 13           | PIM:30                                    | AVDD  | Analog Power (AVDD)          |
| 14           | PIM:31 <sup>(4)</sup>                     | AVSS  | Analog Ground (AGND)         |
| 15           | —   | OA3IN-/AN13/CMP1B/ISRC0/RP49/RC1                    | Not Connected                |
| 16           | —   | OA3IN+/AN14/CMP2B/ISRC1/RP50/RC2                    | Not Connected                |
| 17           | PIM:19                                    | AN17/ANN1/IBIAS1/RP54/RC6                           | Direct Connection            |
| 18           | PIM:02, 16, 37, 46, 62, 86 <sup>(2)</sup> | VDD   | Digital Power (DVDD)         |
| 19           | PIM:15, 36, 45, 65, 75 <sup>(3)</sup>     | VSS   | Digital Ground (DGND)        |
| 20           | PIM:22                                    | AN15/CMP2A/IBIAS2/RP51/RC3                          | Direct Connection            |
| 21           | PIM:63                                    | OSCI/CLKI/AN5/RP32/RB0                              | Direct Connection            |
| 22           | PIM:64                                    | OSCO/CLKO/AN6/RP33/RB1                              | Direct Connection            |
| 23           | PIM:21                                    | AN18/CMP3C/ISRC3/RP74/RD10                          | Direct Connection            |
| 24           | PIM:70                                    | AN16/ISRC2/RP55/RC7                                 | Direct Connection            |
| 25           | PIM:22 <sup>(1)</sup>                     | OA2OUT/AN1/AN7/ANA0/CMP1D/CMP2D/CMP3D/RP34/INT0/RB2 | Connected via 0 Ohm Resistor |
| 26           | —   | PGD2/OA2IN-/AN8/RP35/RB3                            | Not Connected                |
| 27           | —   | PGC2/OA2IN+/RP36/RB4                                | Not Connected                |
| 28           | PIM:49                                    | RP56/ASDA1/SCK2/RC8                                 | Direct Connection            |
| 29           | PIM:68                                    | RP57/ASCL1/SDI2/RC9                                 | Direct Connection            |
| 30           | PIM:18                                    | RP72/SDO2/PCI19/RD8                                 | Direct Connection            |
| 31           | PIM:15, 36, 45, 65, 75 <sup>(3)</sup>     | VSS   | Digital Ground (DGND)        |
| 32           | PIM:02, 16, 37, 46, 62, 86 <sup>(2)</sup> | VDD   | Digital Power (DVDD)         |
| 33           | PIM:27                                    | PGD3/RP37/SDA2/RB5                                  | Direct Connection            |
| 34           | PIM:26                                    | PGC3/RP38/SCL2/RB6                                  | Direct Connection            |
| 35           | PIM:32                                    | TDO/AN2/CMP3A/RP39/RB7                              | Direct Connection            |
| 36           | PIM:61                                    | PGD1/AN10/RP40/SCL1/RB8                             | Direct Connection            |

**Note 1:** The PIM pin is directly connected to the device pin through a 0 Ohm resistor (default), which can be removed if desired.

**2:** Digital Power (DVDD) pins are shorted together on the PIM.

**3:** Digital Ground (DGND) pins are shorted together on the PIM.

**4:** Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R28, on the PIM.

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**TABLE 2: DEVICE TO PIM MAPPING (SORTED BY DEVICE PIN NUMBER) (CONTINUED)**

| Device Pin # | PIM Pin #                                 | dsPIC33CK64MP105 Device Functional Description | Remarks               |
|--------------|---|--|-----------------------|
| 37           | PIM:80                                    | PGC1/AN11/RP41/SDA1/RB9                        | Direct Connection     |
| 38           | PIM:84                                    | RP52/ASDA2/RC4                                 | Direct Connection     |
| 39           | PIM:47                                    | RP53/ASCL2/RC5                                 | Direct Connection     |
| 40           | PIM:48                                    | RP58/RC10                                      | Direct Connection     |
| 41           | PIM:79                                    | RP59/RC11                                      | Direct Connection     |
|              | PIM:83                                    |  |                       |
| 42           | PIM:15, 36, 45, 65, 75 <sup>(3)</sup>     | Vss  | Digital Ground (DGND) |
| 43           | PIM:02, 16, 37, 46, 62, 86 <sup>(2)</sup> | VDD  | Digital Power (DVDD)  |
| 44           | PIM:50                                    | RP65/PWM4H/RD1                                 | Direct Connection     |
| 45           | PIM:03                                    | TMS/RP42/PWM3H/RB10                            | Direct Connection     |
| 46           | PIM:100                                   | TCK/RP43/PWM3L/RB11                            | Direct Connection     |
| 47           | PIM:99                                    | TDI/RP44/PWM2H/RB12                            | Direct Connection     |
| 48           | PIM:98                                    | RP45/PWM2L/RB13                                | Direct Connection     |

- Note 1:** The PIM pin is directly connected to the device pin through a 0 Ohm resistor (default), which can be removed if desired.
- 2:** Digital Power (DVDD) pins are shorted together on the PIM.
- 3:** Digital Ground (DGND) pins are shorted together on the PIM.
- 4:** Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R28, on the PIM.

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Table 3 provides mapping between the 100-pin PIM and the 48-pin device.

**TABLE 3: DEVICE TO PIM MAPPING (SORTED BY PIM PIN NUMBER)**

| PIM Pin #                                 | Device Pin # | dsPIC33CK64MP105 Device Functional Description      | Remarks                      |
|---|--------------|---|------------------------------|
| PIM:01                                    | 4            | RP61/RC13   | Direct Connection            |
| PIM:02, 16, 37, 46, 62, 86 <sup>(2)</sup> | 18, 32, 43   | VDD   | Digital Power (DVDD)         |
| PIM:03                                    | 45           | TMS/RP42/PWM3H/RB10                                 | Direct Connection            |
| PIM:04                                    | —            | —   | Not Connected                |
| PIM:05                                    | —            | —   | Not Connected                |
| PIM:06                                    | —            | —   | Not Connected                |
| PIM:07                                    | —            | —   | Not Connected                |
| PIM:08                                    | —            | —   | Not Connected                |
| PIM:09                                    | —            | —   | Not Connected                |
| PIM:10                                    | —            | —   | Not Connected                |
| PIM:11                                    | —            | —   | Not Connected                |
| PIM:12                                    | —            | —   | Not Connected                |
| PIM:13                                    | 5            | MCLR  | Direct Connection            |
| PIM:14                                    | —            | —   | Not Connected                |
| PIM:15, 36, 45, 65, 75 <sup>(3)</sup>     | 19, 31, 42   | VSS   | Digital Ground (DGND)        |
| PIM:02, 16, 37, 46, 62, 86 <sup>(2)</sup> | 18, 32, 43   | VDD   | Digital Power (DVDD)         |
| PIM:17                                    | —            | —   | Not Connected                |
| PIM:18                                    | 30           | RP72/SDO2/PCI19/RD8                                 | Direct Connection            |
| PIM:19                                    | 17           | AN17/ANN1/IBIAS1/RP54/RC6                           | Direct Connection            |
| PIM:20 <sup>(1)</sup>                     | 11           | DACOUT/AN3/CMP1C/RA3                                | Connected via 0 Ohm Resistor |
| PIM:21 <sup>(1)</sup>                     | 23           | AN18/CMP3C/ISRC3/RP74/RD10                          | Direct Connection            |
|   | 12           | OA3OUT/AN4/CMP3B/IBIAS3/RA4                         | Connected via 0 Ohm Resistor |
| PIM:22 <sup>(1)</sup>                     | 20           | AN15/CMP2A/IBIAS2/RP51/RC3                          | Direct Connection            |
|   | 25           | OA2OUT/AN1/AN7/ANA0/CMP1D/CMP2D/CMP3D/RP34/INT0/RB2 | Connected via 0 Ohm Resistor |
| PIM:23 <sup>(1)</sup>                     | 10           | OA1IN+/AN9/RA2                                      | Connected via 0 Ohm Resistor |
| PIM:24 <sup>(1)</sup>                     | 9            | OA1IN-/ANA1/RA1                                     | Connected via 0 Ohm Resistor |
| PIM:25 <sup>(1)</sup>                     | 8            | OA1OUT/AN0/CMP1A/IBIAS0/RA0                         | Connected via 0 Ohm Resistor |
| PIM:26                                    | 34           | PGC3/RP38/SCL2/RB6                                  | Direct Connection            |
| PIM:27                                    | 33           | PGD3/RP37/SDA2/RB5                                  | Direct Connection            |
| PIM:28                                    | —            | VREF 1.65V  | External 1.65V Reference     |
| PIM:29                                    | —            | —   | Not Connected                |
| PIM:30                                    | 13           | AVDD  | Analog Power (AVDD)          |
| PIM:31 <sup>(4)</sup>                     | 14           | AVSS  | Analog Ground (AGND)         |
| PIM:32                                    | 35           | TDO/AN2/CMP3A/RP39/RB7                              | Direct Connection            |
| PIM:33                                    | —            | —   | Not Connected                |
| PIM:34                                    | —            | —   | Not Connected                |
| PIM:35                                    | 7            | AN12/ANN0/RP48/RC0                                  | Direct Connection            |

- Note 1:** The PIM pin is directly connected to the device pin through a 0 Ohm resistor (default), which can be removed if desired.  
**Note 2:** Digital Power (DVDD) pins are shorted together on the PIM.  
**Note 3:** Digital Ground (DGND) pins are shorted together on the PIM.  
**Note 4:** Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R28, on the PIM.

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**TABLE 3: DEVICE TO PIM MAPPING (SORTED BY PIM PIN NUMBER) (CONTINUED)**

| PIM Pin #                                 | Device Pin # | dsPIC33CK64MP105 Device Functional Description | Remarks               |
|---|--------------|--|-----------------------|
| PIM:15, 36, 45, 65, 75 <sup>(3)</sup>     | 19, 31, 42   | Vss  | Digital Ground (DGND) |
| PIM:02, 16, 37, 46, 62, 86 <sup>(2)</sup> | 18, 32, 43   | VDD  | Digital Power (DVDD)  |
| PIM:38                                    | —            | —  | Not Connected         |
| PIM:39                                    | —            | —  | Not Connected         |
| PIM:40                                    | —            | —  | Not Connected         |
| PIM:41                                    | —            | —  | Not Connected         |
| PIM:42                                    | —            | —  | Not Connected         |
| PIM:43                                    | —            | —  | Not Connected         |
| PIM:44                                    | —            | —  | Not Connected         |
| PIM:45                                    | —            | —  | Not Connected         |
| PIM:46                                    | —            | —  | Not Connected         |
| PIM:47                                    | 39           | RP53/ASCL2/RC5                                 | Direct Connection     |
| PIM:48                                    | 40           | RP58/RC10                                      | Direct Connection     |
| PIM:49                                    | 28           | RP56/ASDA1/SCK2/RC8                            | Direct Connection     |
| PIM:50                                    | 44           | RP65/PWM4H/RD1                                 | Direct Connection     |
| PIM:51                                    | —            | —  | Not Connected         |
| PIM:52                                    | —            | —  | Not Connected         |
| PIM:53                                    | —            | —  | Not Connected         |
| PIM:54                                    | —            | —  | Not Connected         |
| PIM:55                                    | —            | —  | Not Connected         |
| PIM:56                                    | —            | —  | Not Connected         |
| PIM:57                                    | —            | —  | Not Connected         |
| PIM:58                                    | —            | —  | Not Connected         |
| PIM:59                                    | —            | —  | Not Connected         |
| PIM:60                                    | 3            | RP60/RC12                                      | Direct Connection     |
| PIM:61                                    | 36           | PGD1/AN10/RP40/SCL1/RB8                        | Direct Connection     |
| PIM:62                                    | —            | —  | Not Connected         |
| PIM:63                                    | 21           | OSCI/CLKI/AN5/RP32/RB0                         | Direct Connection     |
| PIM:64                                    | 22           | OSCO/CLKO/AN6/RP33/RB1                         | Direct Connection     |
| PIM:15, 36, 45, 65, 75 <sup>(3)</sup>     | 19, 31, 42   | Vss  | Digital Ground (DGND) |
| PIM:66                                    | —            | —  | Not Connected         |
| PIM:67                                    | —            | —  | Not Connected         |
| PIM:68                                    | 29           | RP57/ASCL1/SDI2/RC9                            | Direct Connection     |
| PIM:69                                    | —            | —  | Not Connected         |
| PIM:70                                    | 24           | AN16/ISRC2/RP55/RC7                            | Direct Connection     |
| PIM:71                                    | —            | —  | Not Connected         |
| PIM:72                                    | —            | —  | Not Connected         |
| PIM:73                                    | —            | —  | Not Connected         |
| PIM:74                                    | —            | —  | Not Connected         |
| PIM:75                                    | —            | —  | Not Connected         |
| PIM:76                                    | —            | —  | Not Connected         |

- Note 1:** The PIM pin is directly connected to the device pin through a 0 Ohm resistor (default), which can be removed if desired.  
**2:** Digital Power (DVDD) pins are shorted together on the PIM.  
**3:** Digital Ground (DGND) pins are shorted together on the PIM.  
**4:** Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R28, on the PIM.

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**TABLE 3: DEVICE TO PIM MAPPING (SORTED BY PIM PIN NUMBER) (CONTINUED)**

| PIM Pin # | Device Pin # | dsPIC33CK64MP105 Device Functional Description | Remarks           |
|-----------|--------------|--|-------------------|
| PIM:77    | —            | —  | Not Connected     |
| PIM:78    | 6            | ANN2/RP77/RD13                                 | Direct Connection |
| PIM:79    | 41           | RP59/RC11                                      | Direct Connection |
| PIM:80    | 37           | PGC1/AN11/RP41/SDA1/RB9                        | Direct Connection |
| PIM:81    | —            | —  | Not Connected     |
| PIM:82    | —            | —  | Not Connected     |
| PIM:83    | 41           | RP59/RC11                                      | Direct Connection |
| PIM:85    | 38           | RP52/ASDA2/RC4                                 | Direct Connection |
| PIM:86    | —            | —  | Not Connected     |
| PIM:87    | —            | —  | Not Connected     |
| PIM:88    | —            | —  | Not Connected     |
| PIM:89    | —            | —  | Not Connected     |
| PIM:90    | —            | —  | Not Connected     |
| PIM:91    | —            | —  | Not Connected     |
| PIM:92    | —            | —  | Not Connected     |
| PIM:93    | 2            | RP47/PWM1L/RB15                                | Direct Connection |
| PIM:94    | 1            | RP46/PWM1H/RB14                                | Direct Connection |
| PIM:95    | —            | —  | Not Connected     |
| PIM:96    | —            | —  | Not Connected     |
| PIM:97    | —            | —  | Not Connected     |
| PIM:98    | 48           | RP45/PWM2L/RB13                                | Direct Connection |
| PIM:99    | 47           | TDI/RP44/PWM2H/RB12                            | Direct Connection |
| PIM:100   | 46           | TCK/RP43/PWM3L/RB11                            | Direct Connection |

- Note 1:** The PIM pin is directly connected to the device pin through a 0 Ohm resistor (default), which can be removed if desired.
- 2:** Digital Power (DVDD) pins are shorted together on the PIM.
- 3:** Digital Ground (DGND) pins are shorted together on the PIM.
- 4:** Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R28, on the PIM.





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ISBN: 978-1-5224-4117-5



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