dsPIC33CK64MC105

dsPIC33CK64MC105 Motor Control Plug-In Module (PIM) Information Sheet for External Op Amp Configuration

The dsPIC33CK64MC105 External Op Amp Motor Control PIM (P/N: MA330051-1) is designed to demonstrate the motor control capabilities of the dsPIC33CK64MC105 device using external on-board op amps.

The dsPIC33CK64MC105 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 module and a shared ADC core in the device to enable various 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 onto the J4 header (as shown in Figure 2) on the board. The PIM design also enables stepper motor control using the dsPICDEM MCSM Development Board (DM330022/DM330022-1).

For additional information regarding development boards, refer to the respective user's guide available on the Microchip website (www.microchip.com).

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.

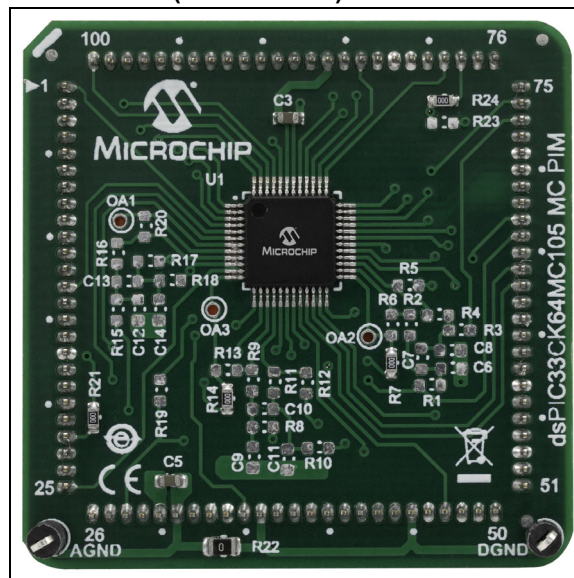**FIGURE 1: dsPIC33CK64MC105 EXTERNAL OP AMP MOTOR CONTROL PIM (MA330051-1)**

FIGURE 2: EXTERNAL OP AMP CONFIGURATION BOARD

dsPIC33CK64MC105

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/DM330022-1	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.

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

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

Device Pin #	PIM Pin #	dsPIC33CK64MC105 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	$\overline{\text{MCLR}}$	Direct Connection
6	PIM:47	ANN0/RP77/RD13	Direct Connection
7	PIM:35	AN12/RP48/RC0	Direct Connection
8	PIM:22	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Connected via 0 Ohm Resistor
9	—	OA1IN-/RA1	Not Connected
10	—	OA1IN+/AN9/RA2	Not Connected
11	PIM:25	DACOUT/AN3/CMP1C/RA3	Direct Connection
12	PIM:20	OA3OUT/AN4/IBIAS3/RA4	Connected via 0 Ohm Resistor
13	PIM:30	AV$_{DD}$	Analog Power (AV$_{DD}$)
14	PIM:31[5]	AV$_{SS}$	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[3]	V$_{DD}$	Digital Power (DV$_{DD}$)
19	PIM:15, 36, 45, 65, 75[4]	V$_{SS}$	Digital Ground (DGND)
20	PIM:32	AN15/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:48	ISRC3/RP74/RD10	Direct Connection
24	PIM:70	ISRC2/RP55/RC7	Direct Connection
25	PIM:21	OA2OUT/AN1/AN7/CMP1D/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/RC8	Direct Connection
29	PIM:68	RP57/ASCL1/SDI2/RC9	Direct Connection
30	PIM:18	RP72/PCI19/RD8	Direct Connection
31	PIM:15, 36, 45, 65, 75[4]	V$_{SS}$	Digital Ground (DGND)
32	PIM:02, 16, 37, 46, 62, 86[3]	V$_{DD}$	Digital Power (DV$_{DD}$)
33	PIM:27	PGD3/RP37/RB5	Direct Connection
34	PIM:26	PGC3/RP38/RB6	Direct Connection
35	PIM:24	TDO/AN2/RP39/RB7	Direct Connection
36	PIM:23	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: The PIM pin can be connected to a device pin through a 0 Ohm resistor, if desired. For proper operation, ensure that other 0 Ohm resistors connected to the same device pin are removed.

3: Digital Power (DV$_{DD}$) pins are shorted together on the PIM.

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

5: Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R22, on the PIM.

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

Device Pin #	PIM Pin #	dsPIC33CK64MC105 Device Functional Description	Remarks
37	PIM:79	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
38	PIM:84	RP52/RC4	Direct Connection
39	PIM:80	RP53/RC5	Direct Connection
40	PIM:61[2]	RP58/RC10	Can be connected via 0 Ohm Resistor
	PIM:78[1]		Connected via 0 Ohm Resistor
41	PIM:83	RP59/RC11	Direct Connection
42	PIM:15, 36, 45, 65, 75[4]	V_{SS}	Digital Ground (DGND)
43	PIM:02, 16, 37, 46, 62, 86[3]	V_{DD}	Digital Power (DV$_{DD}$)
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: The PIM pin can be connected to a device pin through a 0 Ohm resistor, if desired. For proper operation, ensure that other 0 Ohm resistors connected to the same device pin are removed.
    3: Digital Power (DV$_{DD}$) pins are shorted together on the PIM.
    4: Digital Ground (DGND) pins are shorted together on the PIM.
    5: Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R22, on the PIM.

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

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

PIM Pin #	Device Pin #	dsPIC33CK64MC105 Device Functional Description	Remarks
PIM:01	4	RP61/RC13	Direct Connection
PIM:02[3]	18, 32, 43	V$_{DD}$	Digital Power (DV$_{DD}$)
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	$\overline{\text{MCLR}}$	Direct Connection
PIM:14	—	—	Not Connected
PIM:15[4]	19, 31, 42	V$_{SS}$	Digital Ground (DGND)
PIM:16[3]	18, 32, 43	V$_{DD}$	Digital Power (DV$_{DD}$)
PIM:17	—	—	Not Connected
PIM:18	30	RP72/PCI19/RD8	Direct Connection
PIM:19	17	IBIAS1/RP54/RC6	Direct Connection
PIM:20	12	OA3OUT/AN4/IBIAS3/RA4	Connected via 0 Ohm Resistor
PIM:21	25	OA2OUT/AN1/AN7/CMP1D/RP34/INT0/RB2	Connected via 0 Ohm Resistor
PIM:22	8	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Connected via 0 Ohm Resistor
PIM:23	36	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
PIM:24	35	TDO/AN2/RP39/RB7	Direct Connection
PIM:25	11	DACOUT/AN3/CMP1C/RA3	Direct Connection
PIM:26	34	PGC3/RP38/RB6	Direct Connection
PIM:27	33	PGD3/RP37/RB5	Direct Connection
PIM:28	—	V$_{REF}$ 1.65V	External 1.65V Reference
PIM:29	—	—	Not Connected
PIM:30	13	AV$_{DD}$	Analog Power (AV$_{DD}$)
PIM:31[5]	14	AV$_{SS}$	Analog Ground (AGND)
PIM:32	20	AN15/IBIAS2/RP51/RC3	Direct Connection
PIM:33	—	—	Not Connected
PIM:34	—	—	Not Connected
PIM:35	7	AN12/RP48/RC0	Direct Connection
PIM:36[4]	19, 31, 42	V$_{SS}$	Digital Ground (DGND)
PIM:37[3]	18, 32, 43	V$_{DD}$	Digital Power (DV$_{DD}$)
PIM:38	—	—	Not Connected
PIM:39	—	—	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: The PIM pin can be connected to a device pin through a 0 Ohm resistor, if desired. For proper operation, ensure that other 0 Ohm resistors connected to the same device pin are removed.

3: Digital Power (DV$_{DD}$) pins are shorted together on the PIM.

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

5: Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R22, on the PIM.

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

PIM Pin #	Device Pin #	dsPIC33CK64MC105 Device Functional Description	Remarks
PIM:40	—	—	Not Connected
PIM:41	—	—	Not Connected
PIM:42	—	—	Not Connected
PIM:43	—	—	Not Connected
PIM:44	—	—	Not Connected
PIM:45[4]	19, 31, 42	Vss	Digital Ground (DGND)
PIM:46[3]	18, 32, 43	VDD	Digital Power (DVDD)
PIM:47	6	ANN0/RP77/RD13	Direct Connection
PIM:48	23	ISRC3/RP74/RD10	Direct Connection
PIM:49	28	RP56/ASDA1/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[2]	40	RP58/RC10	Can be connected via 0 Ohm Resistor
PIM:62[3]	18, 32, 43	VDD	Digital Power (DVDD)
PIM:63	21	OSCI/CLKI/AN5/RP32/RB0	Direct Connection
PIM:64	22	OSCO/CLKO/AN6/RP33/RB1	Direct Connection
PIM:65[4]	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	ISRC2/RP55/RC7	Direct Connection
PIM:71	—	—	Not Connected
PIM:72	—	—	Not Connected
PIM:73	—	—	Not Connected
PIM:74	—	—	Not Connected
PIM:75[4]	19, 31, 42	Vss	Digital Ground (DGND)
PIM:76	—	—	Not Connected
PIM:77	—	—	Not Connected
PIM:78[1]	40	RP58/RC10	Connected via 0 Ohm Resistor
PIM:79	37	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
PIM:80	39	RP53/RC5	Direct Connection
PIM:81	—	—	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: The PIM pin can be connected to a device pin through a 0 Ohm resistor, if desired. For proper operation, ensure that other 0 Ohm resistors connected to the same device pin are removed.

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

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

5: Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R22, on the PIM.

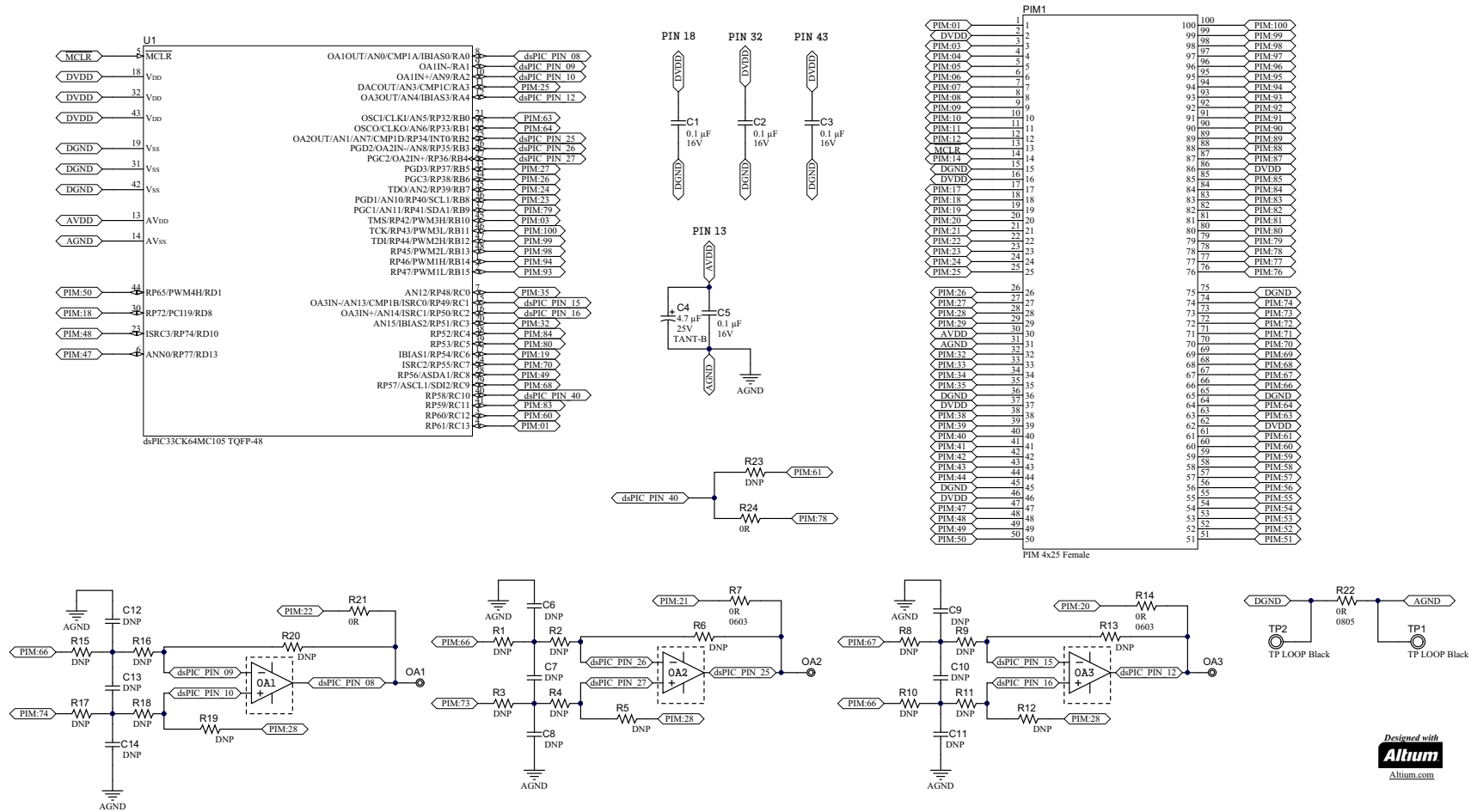**TABLE 3: DEVICE TO PIM MAPPING (SORTED BY PIM PIN NUMBER) (CONTINUED)**

PIM Pin #	Device Pin #	dsPIC33CK64MC105 Device Functional Description	Remarks
PIM:82	—	—	Not Connected
PIM:83	41	RP59/RC11	Direct Connection
PIM:84	38	RP52/RC4	Direct Connection
PIM:85	—	—	Not Connected
PIM:86[3]	18, 32, 43	V$_{DD}$	Digital Power (DV$_{DD}$)
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: The PIM pin can be connected to a device pin through a 0 Ohm resistor, if desired. For proper operation, ensure that other 0 Ohm resistors connected to the same device pin are removed.

3: Digital Power (DV$_{DD}$) pins are shorted together on the PIM.

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

5: Analog Ground (AGND) connection via PIM:31 is shorted with Digital Ground (DGND) through 0 Ohm resistor, R22, on the PIM.

dsPIC33CK64MC105 Motor Control Plug-In Module (PIM) for External Op Amp Configuration

Schematic Revision 1.0

dsPIC33CK64MC105 External Op Amp Motor Control PIM

U1 — dsPIC33CK64MC105 TQFP-48

Pin signals (left side)
MCLR
18 VDD (DVDD)
32 VDD (DVDD)
43 VDD (DVDD)
19 Vss (DGND)
31 Vss (DGND)
42 Vss (DGND)
13 AVDD (AVDD)
14 AVss (AGND)
44 RP65/PWM4H/RD1 (PIM:50)
30 RP72/PCI19/RD8 (PIM:18)
21 ISRC3/RP74/RD10 (PIM:48)
RANN0/RP77/RD13 (PIM:47)

Right side signals:
OA1OUT/AN0/CMP1A/IBIAS0/RA0 — dsPIC_PIN_08
OA1IN-/RA1 — dsPIC_PIN_09
OA1IN+/AN9/RA2 — dsPIC_PIN_10
DACOUT/AN3/CMP1C/RA3 — PIM:25
OA3OUT/AN4/IBIAS3/RA4 — dsPIC_PIN_12
OSCI/CLKI/AN5/RP32/RB0 — PIM:63
OSCO/CLKO/AN6/RP33/RB1 — PIM:64
OA2OUT/AN1/AN7/CMP1D/RP34/INT0/RB2 — dsPIC_PIN_25
PGD2/OA2IN-/AN8/RP35/RB3 — dsPIC_PIN_26
PGC2/OA2IN+/RP36/RB4 — dsPIC_PIN_27
PGD3/RP37/RB5 — PIM:27
PGC3/RP38/RB6 — PIM:26
TDO/AN2/RP39/RB7 — PIM:24
PGD1/AN10/RP40/SCL1/RB8 — PIM:23
PGC1/AN11/RP41/SDA1/RB9 — PIM:79
TMS/RP42/PWM3H/RB10 — PIM:03
TCK/RP43/PWM3L/RB11 — PIM:100
TDI/RP44/PWM2H/RB12 — PIM:99
RP45/PWM2L/RB13 — PIM:98
RP46/PWM1H/RB14 — PIM:94
RP47/PWM1L/RB15 — PIM:93
AN12/RP48/RC0 — PIM:35
OA3IN-/AN13/CMP1B/ISRC0/RP49/RC1 — dsPIC_PIN_15
OA3IN+/AN14/ISRC1/RP50/RC2 — dsPIC_PIN_16
AN15/IBIAS2/RP51/RC3 — PIM:32
RP52/RC4 — PIM:84
RP53/RC5 — PIM:80
IBIAS1/RP54/RC6 — PIM:19
ISRC2/RP55/RC7 — PIM:70
RP56/ASDA1/RC8 — PIM:49
RP57/ASCL1/SDI2/RC9 — PIM:68
RP58/RC10 — dsPIC_PIN_40
RP59/RC11 — PIM:83
RP60/RC12 — PIM:60
RP61/RC13 — PIM:01

PIM1 — PIM 4x25 Female connector (pins 1–100), signals PIM:01 through PIM:100, DVDD, DGND, AVDD, AGND, MCLR.

Decoupling:
- PIN 18: DVDD — C1 0.1 µF 16V — DGND
- PIN 32: DVDD — C2 0.1 µF 16V — DGND
- PIN 43: DVDD — C3 0.1 µF 16V — DGND
- PIN 13: AVDD — C4 4.7 µF 25V TANT-B, C5 0.1 µF 16V — AGND

R23 DNP — dsPIC_PIN_40 / PIM:61
R24 0R — PIM:78

Op Amp stages (bottom):

OA1:
C12 DNP, AGND; R15 DNP (PIM:66), R16 DNP; C13 DNP; R17 DNP (PIM:74), R18 DNP; C14 DNP AGND; R19 DNP; R20 DNP; R21 0R (PIM:22); dsPIC_PIN_09, dsPIC_PIN_10 — OA1 — dsPIC_PIN_08 (OA1), PIM:28

OA2:
AGND; C6 DNP; R1 DNP (PIM:66), R2 DNP; C7 DNP; R3 DNP (PIM:73), R4 DNP; C8 DNP AGND; R5 DNP; R6 DNP; R7 0R 0603 (PIM:21); dsPIC_PIN_26, dsPIC_PIN_27 — OA2 — dsPIC_PIN_25 (OA2), PIM:28

OA3:
AGND; C9 DNP; R8 DNP (PIM:67), R9 DNP; C10 DNP; R10 DNP (PIM:66), R11 DNP; C11 DNP AGND; R12 DNP; R13 DNP; R14 0R 0603 (PIM:20); dsPIC_PIN_15, dsPIC_PIN_16 — OA3 — dsPIC_PIN_12 (OA3), PIM:28

DGND — R22 0R 0805 — AGND
TP2 TP LOOP Black
TP1 TP LOOP Black

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