

dsPIC33EP512GM710 Plug-In Module (PIM) Information Sheet for Single-Dual Motor Control

The dsPIC33EP512GM710 Single-Dual Motor Control PIM is designed to demonstrate the capabilities of the dsPIC33EP512GM710 motor control device, using both internal and external op amps with the Low-Voltage Motor Control Development Bundle (DV330100), by using its 105-pin interface.

The dsPIC33EP512GM710 device is a high-performance, 16-bit Digital Signal Controller (DSC) in a 100-pin TQFP package. This PIM is designed to take advantage of all the features of the device, such as the four internal op amps/comparators, the additional dedicated comparator, the QE1 interface, the two ADC Converters and the two dedicated motor control PWM units (6 PWM generators).

The dsPIC33EP512GM710 Single-Dual Motor PIM takes advantage of these analog peripherals, configured using on-board passive components (resistors and capacitors) to support motor control applications. The PIM is designed to enable driving one or two motors with both internal and external op amps.

In order to operate this device with the Low-Voltage Motor Control Development Bundle, please insert the dsPIC33EP512GM710 Single-Dual Motor Control PIM on the dsPIC[®] DSC Signal Board. [Table 1](#) provides

information on the hardware versions of the motor control boards that are compatible with this PIM. Refer to the User's Guide for the specific motor control board for hardware version identification information.

FIGURE 1: SINGLE-DUAL MOTOR CONTROL PIM

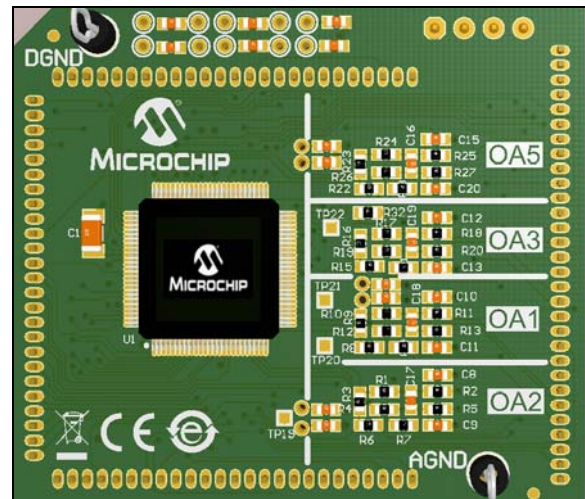


TABLE 1: HARDWARE COMPATIBILITY

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

FIGURE 2: 105-PIN HEADER SCHEMATIC

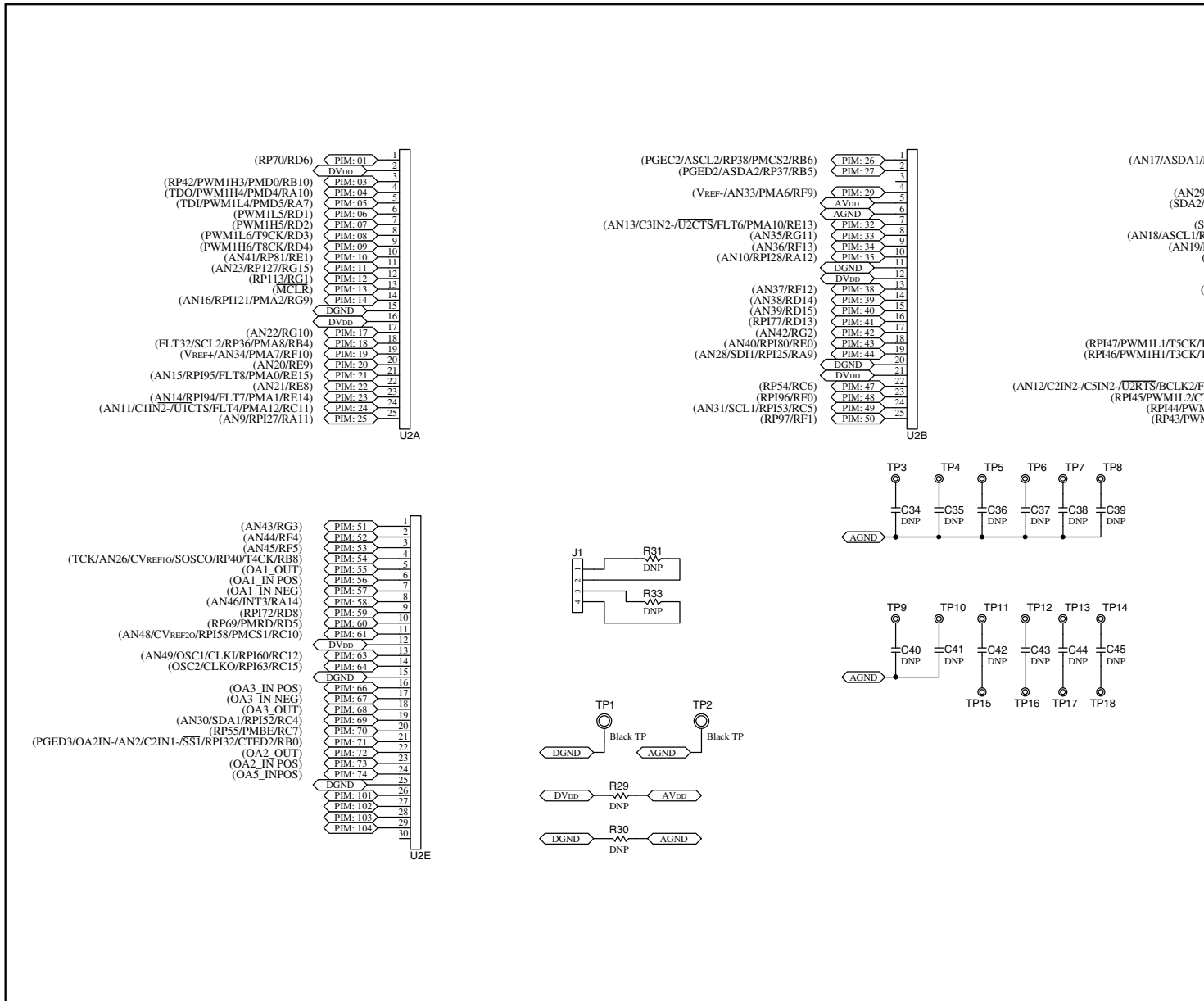
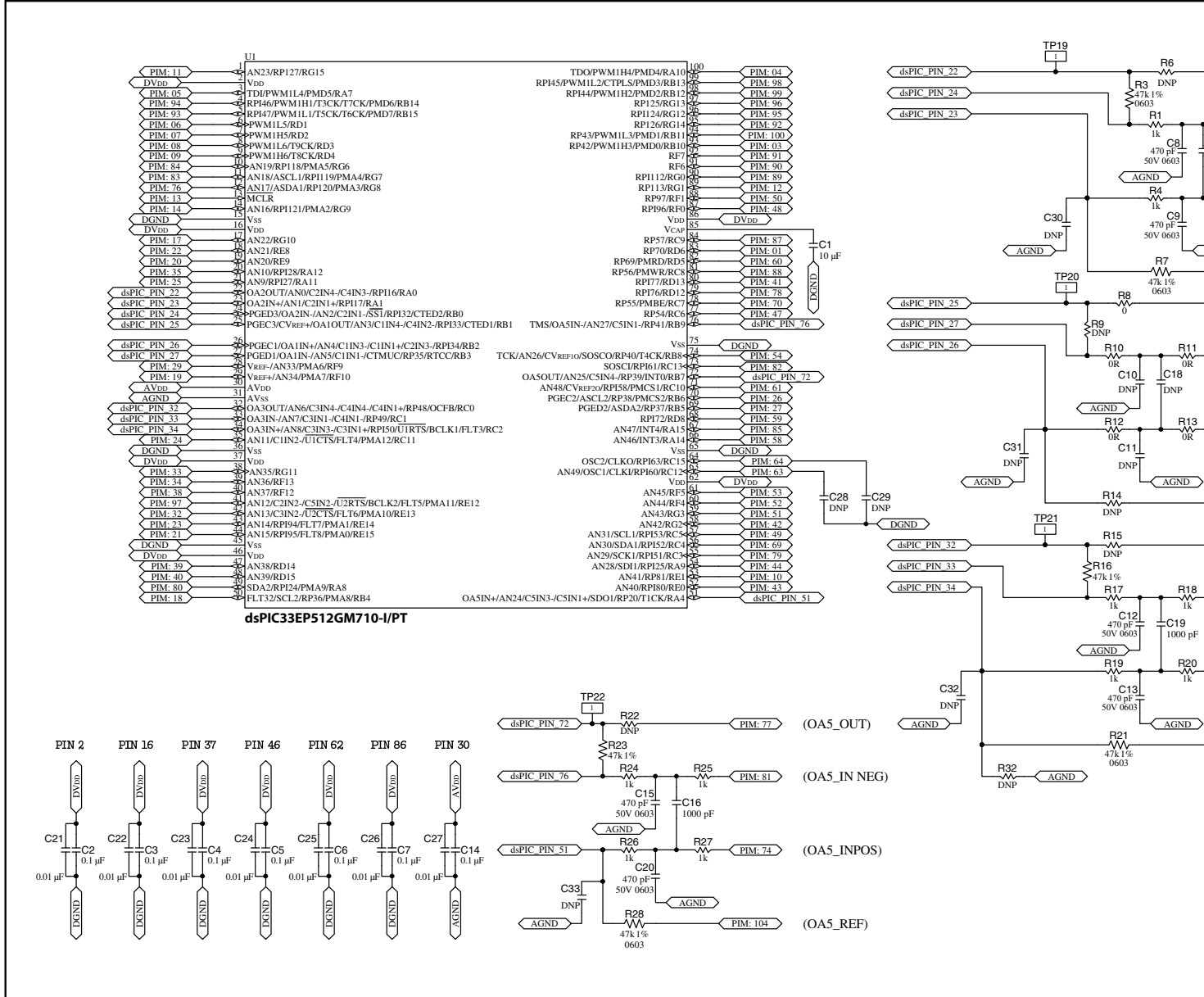


FIGURE 3: 100-PIN DEVICE SCHEMATIC

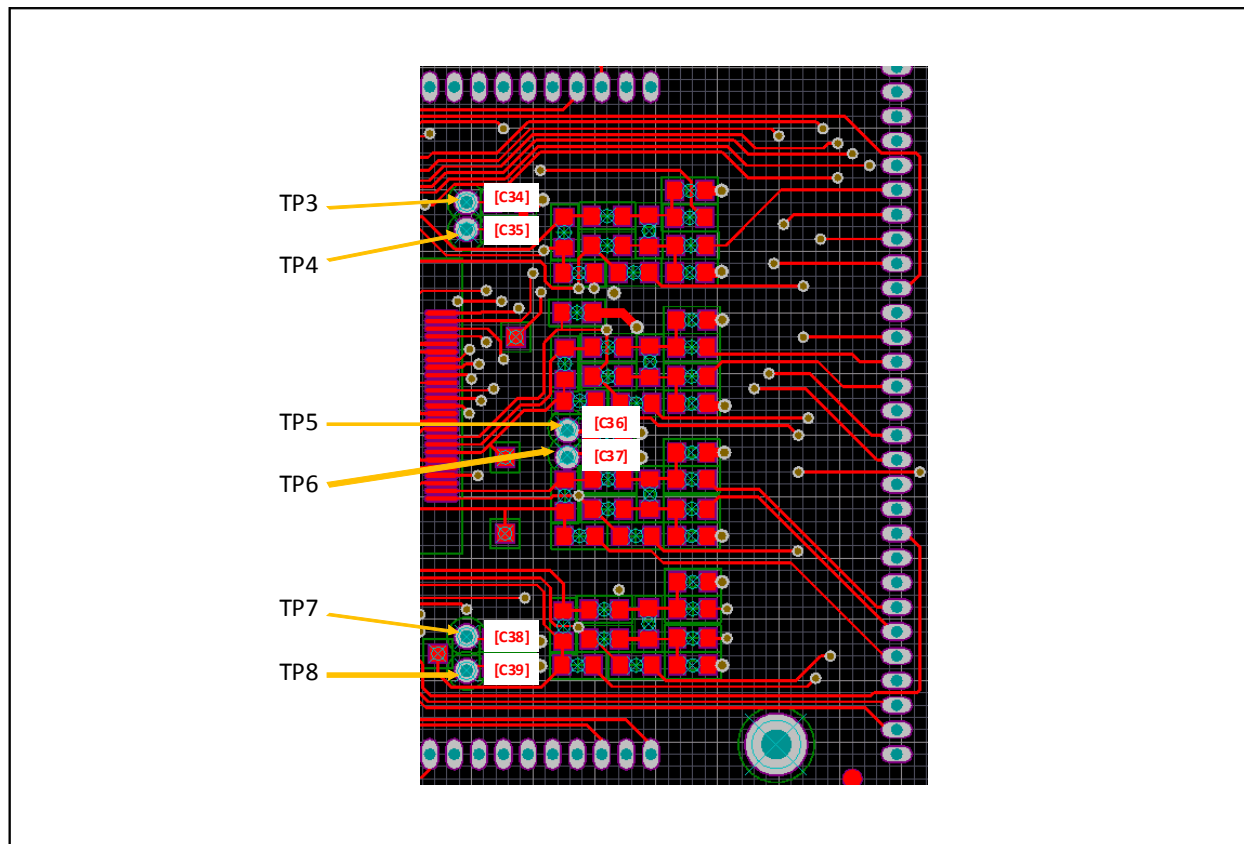


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Connector J1 interacts with the dsPIC DSC Signal Board to have the correct power supply voltage generated. The dsPIC DSC Signal Board is, in fact, capable of generating both 3.3V and 5V. For a correct voltage to be supplied to the dsPIC33EP512GM710, which is 3.3V, neither resistor, R31 nor R33, must be populated.

TP3 to TP8 and C34 to C39, connected to the Analog Ground (AGND), are respectively test points and pads available for additional components to be added if needed; they are all located in the area where the op amp passive components are located. This will help in adding additional local filtering, if needed.

FIGURE 4: AVAILABLE FILTERING LOCATIONS



Four different voltage references, from PIM: 101 to PIM: 104, are used to bias each of the four op amps present on the device. Each op amp reference voltage

is independent from the others, allowing a large versatility in the hardware configuration.

Table 2 provides the mapping between the 105-pin PIM and the 100-pin device pinout.

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

Connector	PIM Pin #	PIM Functional Description on PIM	Device Pin #	dsPIC33EP512GM710 Device Functional Description
U2A-1	PIM:01	Direct Connection	83	RP70/RD6
U2A-2	PIM: 02	Digital Power (DVDD)	2 ⁽²⁾	DVDD
U2A-3	PIM: 03	Direct Connection	93	RP42/PWM1H3/PMPD0/RB10
U2A-4	PIM: 04	Direct Connection	100	TDO/PWM1H4/PMPD4/RA10
U2A-5	PIM: 05	Direct Connection	3	TDI/PWM1L4/PMPD5/RA7
U2A-6	PIM: 06	Direct Connection	6	PWM1L5/RD1
U2A-7	PIM: 07	Direct Connection	7	PWM1H5/RD2
U2A-8	PIM: 08	Direct Connection	8	PWM1L6/T9CK/RD3
U2A-9	PIM: 09	Direct Connection	9	PWM1H6/T8CK/RD4
U2A-10	PIM: 10	Direct Connection	53	AN41/RP81/RE1
U2A-11	PIM: 11	Direct Connection	1	AN23/RP127/RG15
U2A-12	PIM: 12	Direct Connection	89	RP113/RG1
U2A-13	PIM: 13	MCLR	13	MCLR
U2A-14	PIM: 14	Direct Connection	14	AN16/RP1121/PMPA2/RG9
U2A-15	PIM: 15	Digital Ground (DGND)	15 ⁽³⁾	Digital Ground (DGND)
U2A-16	PIM: 16	Digital Power (DVDD)	16 ⁽²⁾	Digital Power (DVDD)
U2A-17	PIM: 17	Direct Connection	17	AN22/RG10
U2A-18	PIM: 18	Direct Connection	50	FLT32/SCL2/RP36/PMPA8/RB4
U2A-19	PIM: 19	Direct Connection	29	VREF+/AN34/PMPA7/RF10
U2A-20	PIM: 20	Direct Connection	19	AN20/RE9
U2A-21	PIM: 21	Direct Connection	44	AN15/RPI95/FLT8/PMPA0/RE15
U2A-22	PIM: 22	Direct Connection	18	AN21/RE8
U2A-23	PIM: 23	Direct Connection	43	AN14/RPI94/FLT7/PMPA1/RE14
U2A-24	PIM: 24	Direct Connection	35	AN11/C1IN2-/U1CTS/FLT4/PMPA12/RC11
U2A-25	PIM: 25	Direct Connection	21	AN9/RPI27/RA11
U2B-1	PIM: 26	Direct Connection	70	PGEC2/ASCL2/RP38/PMPCS2/RB6
U2B-2	PIM: 27	Direct Connection	69	PGED2/ASDA2/RP37/RB5
U2B-3	PIM: 28	Not Connected		
U2B-4	PIM: 29	Direct Connection	28	VREF-/AN33/PMPA6/RF9
U2B-5	PIM: 30	Analog Power (AVDD)	30 ⁽⁴⁾	Analog Power (AVDD)
U2B-6	PIM:31	Analog Ground (AGND)	31 ⁽⁵⁾	Analog Ground (AGND)
U2B-7	PIM:32	Direct Connection	42	AN13/C3IN2-/U2CTS/FLT6/PMPA10/RE13
U2B-8	PIM:33	Direct Connection	38	AN35/RG11
U2B-9	PIM:34	Direct Connection	39	AN36/RF13
U2B-10	PIM:35	Direct Connection	20	AN10/RPI28/RA12
U2B-11	PIM:36	Digital Ground (DGND)	36 ⁽³⁾	Digital Ground (DGND)
U2B-12	PIM:37	Digital Power (DVDD)	37 ⁽²⁾	Digital Power (DVDD)
U2B-13	PIM:38	Direct Connection	40	AN37/RF12
U2B-14	PIM:39	Direct Connection	47	AN38/RD14

Note 1: The device pin is connected to the PIM pin through a passive network. A direct connection can be implemented by removing some components and/or replacing some with 0 Ohm resistors.

- 2:** All DVDD pins are shorted together on the PIM.
- 3:** All DGND pins are shorted together on the PIM.
- 4:** All AVDD pins are shorted together on the PIM.
- 5:** All AGND pins are shorted together on the PIM.

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

Connector	PIM Pin #	PIM Functional Description on PIM	Device Pin #	dsPIC33EP512GM710 Device Functional Description
U2B-15	PIM: 40	Direct Connection	48	AN39/RD15
U2B-16	PIM: 41	Direct Connection	80	RPI77/RD13
U2B-17	PIM: 42	Direct Connection	58	AN42/RG2
U2B-18	PIM: 43	Direct Connection	52	AN40/RPI80/RE0
U2B-19	PIM: 44	Direct Connection	54	AN28/SDI1/RPI25/RA9
U2B-20	PIM: 45	Digital Ground (DGND)	45 ⁽³⁾	Digital Ground (DGND)
U2B-21	PIM: 46	Digital Power (DVDD)	46 ⁽²⁾	Digital Power (DVDD)
U2B-22	PIM: 47	Direct Connection	77	RP54/RC6
U2B-23	PIM: 48	Direct Connection	87	RPI96/RF0
U2B-24	PIM: 49	Direct Connection	57	AN31/SCL1/RPI53/RC5
U2B-25	PIM: 50	Direct Connection	88	RP97/RF1
U2E-1	PIM: 51	Direct Connection	59	AN43/RG3
U2E-2	PIM: 52	Direct Connection	60	AN44/RF4
U2E-3	PIM: 53	Direct Connection	61	AN45/RF5
U2E-4	PIM: 54	Direct Connection	74	TCK/AN26/CVREF10/SOSCO/ RP40/T4CK/RB8
U2E-5	PIM: 55	OA1_OUT	25 ⁽¹⁾	PGEC3/VREF+/CVREF+/OA1OUT/AN3/C1IN4-/C4IN2-/RPI33/CTED1/RB1
U2E-6	PIM: 56	OA1_IN POS	26 ⁽¹⁾	PGEC1/OA1IN+/AN4/C1IN3-/C1IN1+/C2IN3-/RPI34/RB2
U2E-7	PIM: 57	OA1_IN NEG	27 ⁽¹⁾	PGED1/OA1IN-/AN5/C1IN1-/CTMUC/ RP35/RTCC/RB3
U2E-8	PIM: 58	Direct Connection	66	AN46/INT3/RA14
U2E-9	PIM: 59	Direct Connection	68	RPI72/RD8
U2E-10	PIM: 60	Direct Connection	82	RP69/PMPRD/RD5
U2E-11	PIM: 61	Direct Connection	71	AN48/CVREF20/RPI58/PMPCS1/RC10
U2E-12	PIM: 62	Digital Power (DVDD)	62 ⁽²⁾	Digital Power (DVDD)
U2E-13	PIM: 63	Direct Connection	63	AN49/OSC1/CLKI/RPI60/RC12
U2E-14	PIM: 64	Direct Connection	64	OSC2/CLKO/RPI63/RC15
U2E-15	PIM: 65	Digital Ground (DGND)	65 ⁽³⁾	Digital Ground (DGND)
U2E-16	PIM: 66	OA3_IN POS	34 ⁽¹⁾	OA3IN+/AN8/C3IN3-/C3IN1+/RPI50/U1RTS/BCLK1/FLT3/RC2
U2E-17	PIM: 67	OA3_IN NEG	33 ⁽¹⁾	OA3IN-/AN7/C3IN1-/C4IN1-/RP49/RC1
U2E-18	PIM: 68	OA3_OUT	32 ⁽¹⁾	OA3OUT/AN6/C3IN4-/C4IN4-/C4IN1+/RP48/OCFB/RC0
U2E-19	PIM: 69	Direct Connection	56	AN30/SDA1/RPI52/RC4
U2E-20	PIM: 70	Direct Connection	78	RP55/PMPBE/RC7
U2E-21	PIM: 71	OA2_IN NEG	24 ⁽¹⁾	PGED3/OA2IN-/AN2/C2IN1-/SS1/RPI32/CTED2/RB0
U2E-22	PIM: 72	OA2_OUT	22 ⁽¹⁾	OA2OUT/AN0/C2IN4-/C4IN3-/RPI16/RA0
U2E-23	PIM: 73	OA2_IN POS	23 ⁽¹⁾	OA2IN+/AN1/C2IN1+/RPI17/RA1
U2E-24	PIM: 74	OA5_IN POS	51 ⁽¹⁾	OA5IN+/AN24/C5IN3-/C5IN1+/SDO1/ RP20/T1CK/RA4
U2E-25	PIM: 75	Digital Ground (DGND)	75 ⁽³⁾	Digital Ground (DGND)
U2D-1	PIM: 76	Direct Connection	12	AN17/ASDA1/ RP120/PMPA3/RG8
U2D-2	PIM: 77	OA5_OUT	72 ⁽¹⁾	OA5OUT/AN25/C5IN4-/RP39/INT0/RB7
U2D-3	PIM: 78	Direct Connection	79	RPI76/RD12
U2D-4	PIM: 79	Direct Connection	55	AN29/SCK1/RPI51/RC3
U2D-5	PIM: 80	Direct Connection	49	SDA2/RPI24/PMPA9/RA8

Note 1: The device pin is connected to the PIM pin through a passive network. A direct connection can be implemented by removing some components and/or replacing some with 0 Ohm resistors.

- 2:** All DVDD pins are shorted together on the PIM.
- 3:** All DGND pins are shorted together on the PIM.
- 4:** All AVDD pins are shorted together on the PIM.
- 5:** All AGND pins are shorted together on the PIM.

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

Connector	PIM Pin #	PIM Functional Description on PIM	Device Pin #	dsPIC33EP512GM710 Device Functional Description
U2D-6	PIM: 81	OA5_IN NEG	76 ⁽¹⁾	TMS/OA5IN-/AN27/C5IN1-/RP41/RB9
U2D-7	PIM: 82	Direct Connection	73	SOSCI/RPI61/RC13
U2D-8	PIM: 83	Direct Connection	11	AN18/ASCL1/RPI119/PMPA4/RG7
U2D-9	PIM: 84	Direct Connection	10	AN19/RP118/PMPA5/RG6
U2D-10	PIM: 85	Direct Connection	67	AN47/INT4/RA15
U2D-11	PIM: 86	Digital Power (DVDD)	86 ⁽²⁾	Digital Power (DVDD)
U2D-12	PIM: 87	Direct Connection	84	RP57/RC9
U2D-13	PIM: 88	Direct Connection	81	RP56/PMPWR/RC8
U2D-14	PIM: 89	Direct Connection	90	RPI112/RG0
U2D-15	PIM: 90	Direct Connection	91	RF6
U2D-16	PIM: 91	Direct Connection	92	RF7
U2D-17	PIM: 92	Direct Connection	95	RP126/RG14
U2D-18	PIM: 93	Direct Connection	5	RPI47/PWM1L1/T5CK/T6CK/PMPD7/RB15
U2D-19	PIM: 94	Direct Connection	4	RPI46/PWM1H1/T3CK/T7CK/PMPD6/RB14
U2D-20	PIM: 95	Direct Connection	96	RP124/RG12
U2D-21	PIM: 96	Direct Connection	97	RP125/RG13
U2D-22	PIM: 97	Direct Connection	41	AN12/C2IN2-/C5IN2-/U2RTS/BCLK2/FLT5/PMPA11/RE12
U2D-23	PIM: 98	Direct Connection	99	RPI45/PWM1L2/CTPLS/PMPD3/RB13
U2D-24	PIM: 99	Direct Connection	98	RPI44/PWM1H2/PMPD2/RB12
U2D-25	PIM: 100	Direct Connection	94	RP43/PWM1L3/PMPD1/RB11
U2E-26	PIM: 101	OA1_REF	26 ⁽¹⁾	Indirect Connection
U2E-27	PIM: 102	OA2_REF	23 ⁽¹⁾	Indirect Connection
U2E-28	PIM: 103	OA3_REF	34 ⁽¹⁾	Indirect Connection
U2E-29	PIM: 104	OA5_REF	51 ⁽¹⁾	Indirect Connection
U2E-30	PIM: 105	Not Connected		
			85	VCAP

Note 1: The device pin is connected to the PIM pin through a passive network. A direct connection can be implemented by removing some components and/or replacing some with 0 Ohm resistors.

- 2:** All DVDD pins are shorted together on the PIM.
- 3:** All DGND pins are shorted together on the PIM.
- 4:** All AVDD pins are shorted together on the PIM.
- 5:** All AGND pins are shorted together on the PIM.

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

TABLE 3: 100-PIN DEVICE TO 10-PIN PIM MAPPING (SORTED BY DEVICE PIN NUMBER)

Device Pin #	dsPIC33EP512GM710 Device Functional Description	PIM Pin #	PIM Functional Description on Low-Voltage Motor Control Development Bundle
1	AN23/RP127/RG15	PIM: 11	Direct Connection
2 ⁽²⁾	Digital Power (DVDD)	PIM: 02	Digital Power (DVDD)
3	TDI/PWM1L4/PMPD5/RA7	PIM: 05	Direct Connection
4	RPI46/PWM1H1/T3CK/T7CK/PMPD6/RB14	PIM: 94	Direct Connection
5	RPI47/PWM1L1/T5CK/T6CK/PMPD7/RB15	PIM: 93	Direct Connection
6	PWM1L5/RD1	PIM: 06	Direct Connection
7	PWM1H5/RD2	PIM: 07	Direct Connection
8	PWM1L6/T9CK/RD3	PIM: 08	Direct Connection
9	PWM1H6/T8CK/RD4	PIM: 09	Direct Connection
10	AN19/RP118/PMPA5/RG6	PIM: 84	Direct Connection
11	AN18/ASCL1/RPI119/PMPA4/RG7	PIM: 83	Direct Connection
12	AN17/ASDA1/RP120/PMPA3/RG8	PIM: 76	Direct Connection
13	MCLR	PIM: 131	MCLR
14	AN16/RPI121/PMPA2/RG9	PIM: 14	Direct Connection
15 ⁽³⁾	Digital Ground (DGND)	PIM: 15	Digital Ground (DGND)
16 ⁽²⁾	Digital Power (DVDD)	PIM: 16	Digital Power (DVDD)
17	AN22/RG10	PIM: 17	Direct Connection
18	AN21/RE8	PIM: 22	Direct Connection
19	AN20/RE9	PIM: 20	Direct Connection
20	AN10/RPI28/RA12	PIM: 35	Direct Connection
21	AN9/RPI27/RA11	PIM: 25	Direct Connection
22 ⁽¹⁾	OA2OUT/AN0/C2IN4-/C4IN3-/RPI16/RA0	PIM: 72	OA2_OUT
23 ⁽¹⁾	OA2IN+/AN1/C2IN1+/RPI17/RA1	PIM: 73	OA2_IN POS
24 ⁽¹⁾	PGED3/OA2IN-/AN2/C2IN1-/SS1/RPI32/CTED2/RB0	PIM: 71	OA2_IN NEG
25 ⁽¹⁾	PGEC3/VREF+/CVREF+/OA1OUT/AN3/C1IN4-/C4IN2-/RPI33/CTED1/RB1	PIM: 55	OA1_OUT
26 ⁽¹⁾	PGEC1/OA1IN+/AN4/C1IN3-/C1IN1+/C2IN3-/RPI34/RB2	PIM: 56	OA1_IN POS
27 ⁽¹⁾	PGED1/OA1IN-/AN5/C1IN1-/CTMUC/RP35/RTCC/RB3	PIM: 57	OA1_IN NEG
28	VREF-/AN33/PMPA6/RF9	PIM: 29	Direct Connection
29	VREF+/AN34/PMPA7/RF10	PIM: 19	Direct Connection
30 ⁽⁴⁾	Analog Power (AVDD)	PIM: 30	Analog Power (AVDD)
31 ⁽⁵⁾	Analog Ground (AGND)	PIM: 31	Analog Ground (AGND)
32 ⁽¹⁾	OA3OUT/AN6/C3IN4-/C4IN4-/C4IN1+/RP48/OCFB/RC0	PIM: 68	OA3_OUT
33 ⁽¹⁾	OA3IN-/AN7/C3IN1-/C4IN1-/RP49/RC1	PIM: 67	OA3_IN NEG
34 ⁽¹⁾	OA3IN+/AN8/C3IN3-/C3IN1+/RPI50/U1RTS/BCLK1/FLT3/RC2	PIM: 66	OA3_IN POS
35	AN11/C1IN2-/U1CTS/FLT4/PMPA12/RC11	PIM: 24	Direct Connection
36 ⁽³⁾	Digital Ground (DGND)	PIM: 36	Digital Ground (DGND)
37 ⁽²⁾	Digital Power (DVDD)	PIM: 37	Digital Power (DVDD)
38	AN35/RG11	PIM: 33	Direct Connection
39	AN36/RF13	PIM: 34	Direct Connection

- Note 1:** The device pin is connected to the PIM pin through a passive network. A direct connection can be implemented by removing some components and/or replacing some with 0 Ohm resistors.
- 2:** All DVDD pins are shorted together on the PIM.
- 3:** All DGND pins are shorted together on the PIM.
- 4:** All AVDD pins are shorted together on the PIM.
- 5:** All AGND pins are shorted together on the PIM.

TABLE 3: 100-PIN DEVICE TO 10-PIN PIM MAPPING (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	dsPIC33EP512GM710 Device Functional Description	PIM Pin #	PIM Functional Description on Low-Voltage Motor Control Development Bundle
40	AN37/RF12	PIM: 38	Direct Connection
41	AN12/C2IN2-/C5IN2-/U2RTS/BCLK2/FLT5/PMPA11/RE12	PIM: 97	Direct Connection
42	AN13/C3IN2-/U2CTS/FLT6/PMPA10/RE13	PIM: 32	Direct Connection
43	AN14/RPI94/FLT7/PMPA1/RE14	PIM: 23	Direct Connection
44	AN15/RPI95/FLT8/PMPA0/RE15	PIM: 21	Direct Connection
45 ⁽³⁾	Digital Ground (DGND)	PIM: 45	Digital Ground (DGND)
46 ⁽²⁾	Digital Power (DVDD)	PIM: 46	Digital Power (DVDD)
47	AN38/RD14	PIM: 39	Direct Connection
48	AN39/RD15	PIM: 40	Direct Connection
49	SDA2/RPI24/PMPA9/RA8	PIM: 80	Direct Connection
50	FLT32/SCL2/RP36/PMPA8/RB4	PIM: 18	Direct Connection
51 ⁽¹⁾	OA5IN+/AN24/C5IN3-/C5IN1+/SDO1/RP20/T1CK/RA4	PIM: 74	OA5_IN POS
52	AN40/RPI80/RE0	PIM: 43	Direct Connection
53	AN41/RP81/RE1	PIM: 10	Direct Connection
54	AN28/SDI1/RPI25/RA9	PIM: 44	Direct Connection
55	AN29/SCK1/RPI51/RC3	PIM: 79	Direct Connection
56	AN30/SDA1/RPI52/RC4	PIM: 69	Direct Connection
57	AN31/SCL1/RPI53/RC5	PIM: 49	Direct Connection
58	AN42/RG2	PIM: 42	Direct Connection
59	AN43/RG3	PIM: 51	Direct Connection
60	AN44/RF4	PIM: 52	Direct Connection
61	AN45/RF5	PIM: 53	Direct Connection
62 ⁽²⁾	Digital Power (DVDD)	PIM: 62	Digital Power (DVDD)
63	AN49/OSC1/CLKI/RPI60/RC12	PIM: 63	Direct Connection
64	OSC2/CLKO/RPI63/RC15	PIM: 64	Direct Connection
65 ⁽³⁾	Digital Ground (DGND)	PIM: 65	Digital Ground (DGND)
66	AN46/INT3/RA14	PIM: 58	Direct Connection
67	AN47/INT4/RA15	PIM: 85	Direct Connection
68	RPI72/RD8	PIM: 59	Direct Connection
69	PGED2/ASDA2/RP37/RB5	PIM: 27	Direct Connection
70	PGEC2/ASCL2/RP38/PMPCS2/RB6	PIM: 26	Direct Connection
71	AN48/CVREF20/RPI58/PMPCS1/RC10	PIM: 61	Direct Connection
72 ⁽¹⁾	OA5OUT/AN25/C5IN4-/RP39/INT0/RB7	PIM: 77	OA5_OUT
73	SOSCI/RPI61/RC13	PIM: 82	Direct Connection
74	TCK/AN26/CVREF10/SOSCO/RP40/T4CK/RB8	PIM: 54	Direct Connection
75 ⁽³⁾	Digital Ground (DGND)	PIM: 75	Digital Ground (DGND)
76 ⁽¹⁾	TMS/OA5IN-/AN27/C5IN1-/RP41/RB9	PIM: 81	OA5_IN NEG
77	RP54/RC6	PIM: 47	Direct Connection
78	RP55/PMPBE/RC7	PIM: 70	Direct Connection
79	RPI76/RD12	PIM: 78	Direct Connection
80	RPI77/RD13	PIM: 41	Direct Connection
81	RP56/PMPWR/RC8	PIM: 88	Direct Connection
82	RP69/PMPRD/RD5	PIM: 60	Direct Connection
83	RP70/RD6	PIM: 01	Direct Connection

Note 1: The device pin is connected to the PIM pin through a passive network. A direct connection can be implemented by removing some components and/or replacing some with 0 Ohm resistors.

- 2:** All DVDD pins are shorted together on the PIM.
- 3:** All DGND pins are shorted together on the PIM.
- 4:** All AVDD pins are shorted together on the PIM.
- 5:** All AGND pins are shorted together on the PIM.

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TABLE 3: 100-PIN DEVICE TO 10-PIN PIM MAPPING (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	dsPIC33EP512GM710 Device Functional Description	PIM Pin #	PIM Functional Description on Low-Voltage Motor Control Development Bundle
84	RP57/RC9	PIM: 87	Direct Connection
85	VCAP	X	Device Reserved
86 ⁽²⁾	Digital Power (DVDD)	PIM: 86	Digital Power (DVDD)
87	RPI96/RF0	PIM: 48	Direct Connection
88	RP97/RF1	PIM: 50	Direct Connection
89	RP113/RG1	PIM: 12	Direct Connection
90	RPI112/RG0	PIM: 89	Direct Connection
91	RF6	PIM: 90	Direct Connection
92	RF7	PIM: 91	Direct Connection
93	RP42/PWM1H3/PMPD0/RB10	PIM: 03	Direct Connection
94	RP43/PWM1L3/PMPD1/RB11	PIM: 100	Direct Connection
95	RP126/RG14	PIM: 92	Direct Connection
96	RPI124/RG12	PIM: 95	Direct Connection
97	RP125/RG13	PIM: 96	Direct Connection
98	RPI44/PWM1H2/PMPD2/RB12	PIM: 99	Direct Connection
99	RPI45/PWM1L2/CTPLS/PMPD3/RB13	PIM: 98	Direct Connection
100	TDO/PWM1H4/PMPD4/RA10	PIM: 04	Direct Connection
		PIM: 101	OA1_REF
		PIM: 102	OA2_REF
		PIM: 103	OA3_REF
		PIM: 104	OA5_REF
		PIM: 105	Not Connected
		PIM: 28	Not Connected

- Note 1:** The device pin is connected to the PIM pin through a passive network. A direct connection can be implemented by removing some components and/or replacing some with 0 Ohm resistors.
- 2:** All DVDD pins are shorted together on the PIM.
 - 3:** All DGND pins are shorted together on the PIM.
 - 4:** All AVDD pins are shorted together on the PIM.
 - 5:** All AGND pins are shorted together on the PIM.

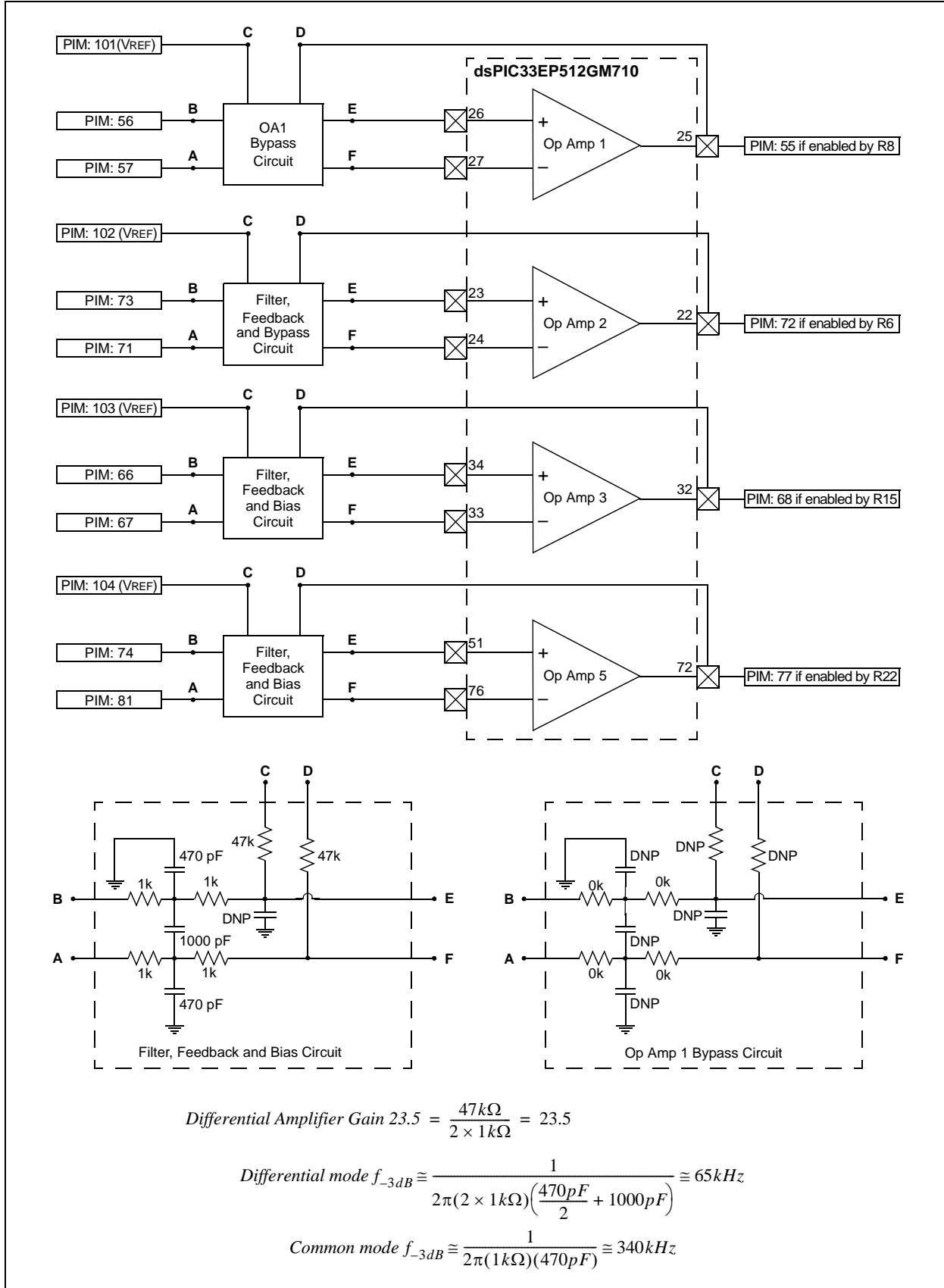
Table 4 classifies the passive components according to their functionalities and also presents the design equations applicable in each case.

TABLE 4: ANALOG FUNCTION LISTING

Op Amp #	Analog Function	Passive Components	Design Equations
1	Low-Pass Filter	R10, R11, R12, R13, C10, C11, C18	$R10 = R11 = R12 = R13 = R$ $C10 = C11 = C$ $R9 = R14$
	Reference Voltage Bias	R9, R14	$Common\text{-}mode\ f_{-3dB} \cong \frac{1}{2\pi RC}$
	Differential Amplifier Input	R10, R11, R12, R13	$Differential\ mode\ f_{-3dB} \cong \frac{1}{2\pi(2R)\left(\frac{C}{2} + C_{18}\right)}$
	Differential Amplifier Feedback	R9	$Differential\ Amplifier\ Gain = \frac{R_9}{2R}$
2	Low-Pass Filter	R1, R2, R4, R5, C8, C9, C17	$R1 = R2 = R4 = R5 = R$ $C8 = C9 = C$ $R3 = R7$
	Reference Voltage Bias	R3, R7	$Common\text{-}mode\ f_{-3dB} \cong \frac{1}{2\pi RC}$
	Differential Amplifier Input	R1, R2, R4, R5	$Differential\ mode\ f_{-3dB} \cong \frac{1}{2\pi(2R)\left(\frac{C}{2} + C_{17}\right)}$
	Differential Amplifier Feedback	R3	$Differential\ Amplifier\ Gain = \frac{R_3}{2R}$
3	Low-Pass Filter	R17, R18, R19, R20, C12, C13, C19	$R17 = R18 = R19 = R20 = R$ $C12 = C13 = C$ $R16 = R21$
	Reference Voltage Bias	R16, R21	$Common\text{-}mode\ f_{-3dB} \cong \frac{1}{2\pi RC}$
	Differential Amplifier Input	R17, R18, R19, R20	$Differential\ mode\ f_{-3dB} \cong \frac{1}{2\pi(2R)\left(\frac{C}{2} + C_{19}\right)}$
	Differential Amplifier Feedback	R16	$Differential\ Amplifier\ Gain = \frac{R_{16}}{2R}$
5	Low-Pass Filter	R24, R25, R26, R27, C15, C16, C20	$R24 = R25 = R26 = R27 = R$ $C15 = C20 = C$ $R23 = R28$
	Reference Voltage Bias	R23, R28	$Common\text{-}mode\ f_{-3dB} \cong \frac{1}{2\pi RC}$
	Differential Amplifier Input	R24, R25, R26, R27	$Differential\ mode\ f_{-3dB} \cong \frac{1}{2\pi(2R)\left(\frac{C}{2} + C_{16}\right)}$
	Differential Amplifier Feedback	R23	$Differential\ Amplifier\ Gain = \frac{R_{23}}{2R}$

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FIGURE 5: INTERNAL OP AMPS CIRCUIT SCHEMATIC



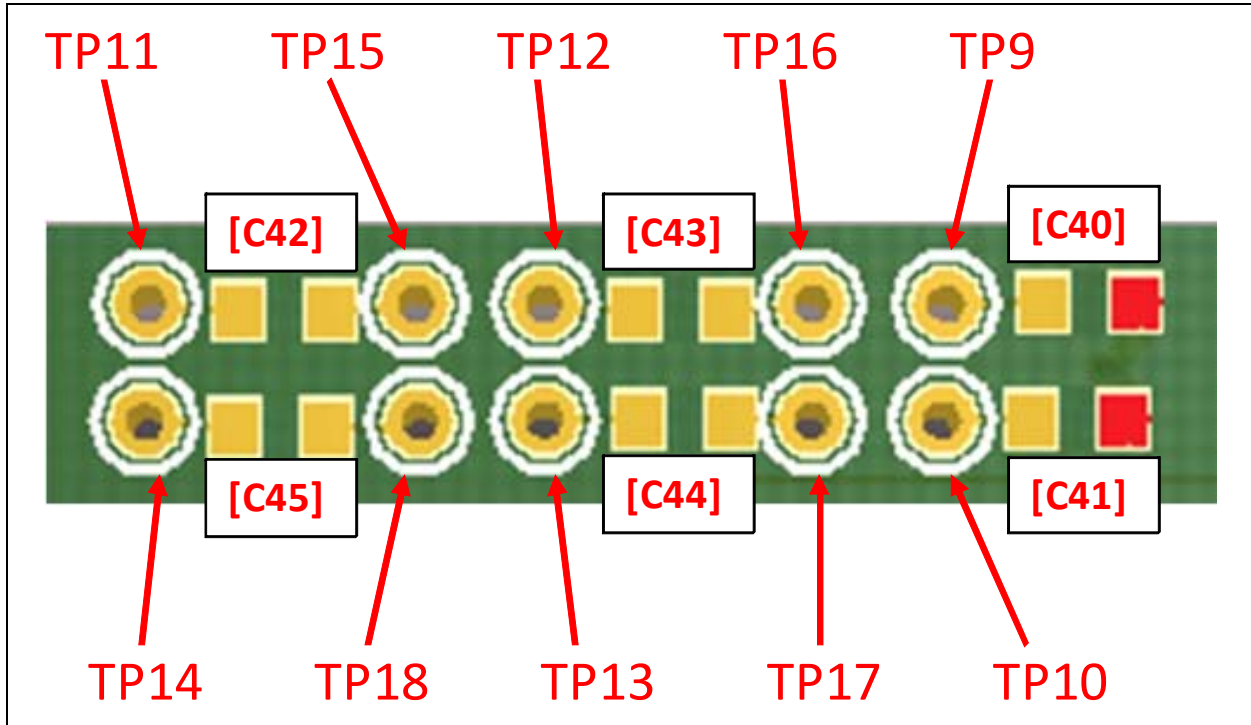
Prototyping Area

The prototyping area is located on the upper side of the Single-Dual Motor Control PIM (see [Figure 6](#)).

TP9 to TP18 and C40 to C45 are holes and pads available for further enhancement and prototyping directly on the PIM. The right pads (marked with red) are internally

connected to Analog Ground (AGND). The rest of the pads are connected only to the nearest test point. With this configuration, extra SMD resistors or capacitors can be added to the circuit by soldering them on the pads, and then soldering blue wires from the test points to the place on the PIM where the added components are needed.

FIGURE 6: PROTOTYPING AREA



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NOTES:

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