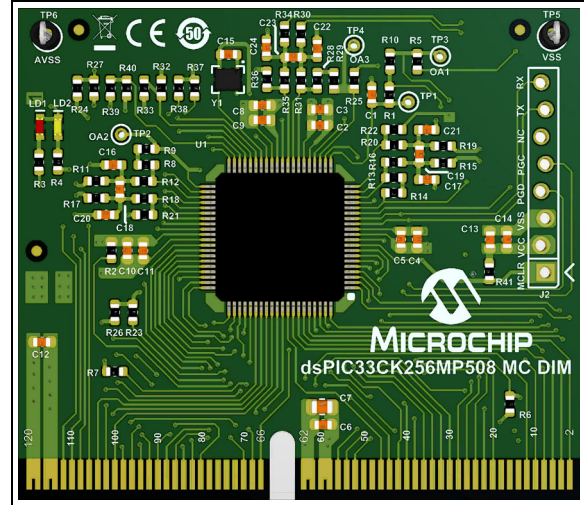


dsPIC33CK256MP508 Motor Control Dual In-Line Module (DIM) Information Sheet

The dsPIC33CK256MP508 Motor Control DIM (P/N: EV62P66A) is designed to demonstrate the motor control capabilities of the dsPIC33CK256MP508 device. The dsPIC33CK256MP508 device is a high-performance, 16-bit Digital Signal Controller (DSC). This Motor Control DIM is designed to take advantage of the high-resolution PWM module (with fine edge placement), two dedicated ADC cores, a shared ADC core and operational amplifiers in the device to enable various motor control applications. The DIM can be used to demonstrate and develop motor control applications by inserting it in the DIM interface header, provided on the compatible motor control development boards (see [Table 1](#)). The DIM is designed to run a single motor with all the compatible development boards. 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 DIM.

FIGURE 1: dsPIC33CK256MP508 MOTOR CONTROL DIM (P/N: EV62P66A)



The 8-pin header J2 is provided for interfacing the programmer/debugger. This is not populated by default. When needed, populate the connector with Part Number 68016-108HLF or similar.

The LED LD1 indicates the power-on status of the DIM. A general purpose LED LD2 is provided on the board for debug purposes. An RC filter (R1, C1) is provided on the DIM to filter the DC bus current before connecting it to the input of Comparator 1 (CMP1C), which is internal to the dsPIC[®] DSC. If needed, the filter cutoff frequency can be modified by changing the values of the filter components. The clock for the dsPIC DSC is generated by the MEMS Oscillator (Y1 – DSC6011J12B-008.0000) provided on the DIM.

TABLE 1: HARDWARE COMPATIBILITY⁽¹⁾

Compatible Development Board	Part Number	Compatible Hardware Revision
MCLV-48V-300W	EV18H47A	All Revisions

Note 1: The DIM is not compatible with earlier motor control development boards (e.g., dsPICDEM™ MCLV-2 Development Board, dsPICDEM MCHV-3 Development Board).

WARNING

Do not connect non-isolated oscilloscope probes to the test points on the DIM when inserted in use with the High-Voltage Development Board. Failure to heed this warning could result in hardware damage.

dsPIC33CK256MP508

Table 2 provides pin mapping from the 80-pin dsPIC33CK256MP508 device to the DIM interface connector.

TABLE 2: PIN MAPPING – dsPIC33CK256MP508 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER)

Device Pin #	DIM Pin #	dsPIC33CK256MP508 Pin Functional Description	Remarks
1	DIM:001	RP46/PWM1H/PMD5/RB14	Direct Connection
2	DIM:082	AN20/RE0	Direct Connection
3	DIM:003	RP47/PWM1L/PMD6/RB15	Direct Connection
4	DIM:084	AN21/RE1	Direct Connection
5	DIM:091	RP60/PWM8H/PMD7/RC12	Direct Connection
6	DIM:092	RP61/PWM8L/PMA5/RC13	Direct Connection
7	DIM:089	RP62/PWM6H/PMA4/RC14	Direct Connection
8	DIM:090	RP63/PWM6L/PMA3/RC15	Direct Connection
9	DIM:047 (MCLR)	MCLR	Direct Connection. Additionally, this device pin connects to Pin 1 of the ICSP™ header J2.
10	DIM:080	RP79/PCI22/PMA2/RD15	Direct Connection
11	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
12	DIM:057 to DIM:60, DIM:113 to DIM:116	VDD	Digital Power (VDD)
13	DIM:052	RP78/PCI21/RD14	Direct Connection
14	DIM:054	ANN2/RP77/RD13	Direct Connection
15	DIM:022	AN12/ANN0/RP48/RC0	Direct Connection
16	DIM:033	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Output of Internal Op Amp 1 if: • Configured and enabled Op Amp 1 • Populated R14 • Removed R5, R7 and R10
	DIM:010		Can be connected via 0R resistor (R5)
	DIM:095		Can be connected via 0R resistor (R7)
	DIM:035		Can be connected via 0R resistor (R10)
17	DIM:081	AN22/RE2	Direct Connection
18	DIM:031	OA1IN-/ANA1/RA1	Op Amp 1 Negative Input
19	DIM:083	AN23/RE3	Direct Connection
20	DIM:029	OA1IN+/AN9/PMA6/RA2	Op Amp 1 Positive Input
21	DIM:035	DACOUT1/AN3/CMP1C/RA3	Connected through filter R1 and C1
22	DIM:096	RE4	Direct Connection
23	DIM:025	OA3OUT/AN4/CMP3B/IBIAS3/RA4	Output of Internal Op Amp 3 if: • Configured and enabled Op Amp 3 • Populated R29 • Removed R25
	DIM:027		Can be connected via 0R resistor (R25)
24	DIM:065	RE5	Connected via 0R resistor (R24)
	DIM:038		Can be connected via 0R resistor (R27)
25	DIM:057 to DIM:60, DIM:113 to DM:116	AVDD	Analog Power (AVCC) connected to Vcc through Net Tie NT1
26	DIM:061 to DIM:064, DIM:117 to DIM:120	AVss	Analog Ground (AVss) connected to Vss through Net Tie NT2
27	DIM:040	RP76/RD12	Connected via 0R resistor (R37)
	DIM:067		Can be connected via 0R resistor (R38)

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TABLE 2: PIN MAPPING – dsPIC33CK256MP508 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	DIM Pin #	dsPIC33CK256MP508 Pin Functional Description	Remarks
28	DIM:023	OA3IN-/AN13/CMP1B/ISRC0/RP49/PMA7/RC1	Op Amp 3 Negative Input
29	DIM:021	OA3IN+/AN14/CMP2B/ISRC1/RP50/PMD13/PMA13/RC2	Op Amp 3 Positive Input
30	DIM:028	AN17/ANN1/IBIAS1/RP54/PMD12/PMA12/RC6	Direct Connection
31	DIM:057 to DIM:60, DIM:113 to DIM:116	VDD	Digital Power (Vcc)
32	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
33	DIM:039	AN15/CMP2A/IBIAS2/RP51/PMD11/PMA11/RC3	Direct Connection
34	CLKI	OSCI/CLKI/AN5/RP32/PMD10/PMA10/RB0	Clock Output of MEMS Oscillator (Y1) is connected as Input Clock
35	DIM:071	OSCO/CLKO/AN6/RP33/PMA1/PMALH/PSA1/RB1	Direct Connection
36	DIM:026	AN19/CMP2C/RP75/PMA0/PMALL/PSA0/RD11	Connected via 0R resistor (R32)
	DIM:094		Can be connected via 0R resistor (R33)
37	DIM:085	RE6	Direct Connection
38	DIM:024	AN18/CMP3C/ISRC3/RP74/PMD9/PMA9/RD10	Direct Connection
39	DIM:045	RE7	Connected via 0R resistor (R39)
	DIM:087		Can be connected via 0R resistor (R40)
40	DIM:020	AN16/ISRC2/RP55/PMD8/PMA8/RC7	Direct Connection
41	DIM:017	OA2OUT/AN1/AN7/ANA0/CMP1D/CMP2D/CMP3D/ RP34/SCL3/INT0/RB2	Output of Internal Op Amp 2 if: • Configured and enabled Op Amp 2 • Populated R9 • Removed R6
	DIM:019		Can be connected via 0R resistor (R6)
42	DIM:056	RE8	Direct Connection; this pin is also connected to a General Purpose LED LD2 on the DIM
43	DIM:015	PGD2/OA2IN-/AN8/RP35/RB3	Op Amp 2 Negative Input
44	DIM:106	RE9	Direct Connection
45	DIM:013	PGC2/OA2IN+/RP36/RB4	Op Amp 2 Positive Input
46	DIM:112	RP56/ASDA1/SCK2/RC8	Direct Connection
47	DIM:110	RP57/ASCL1/SDI2/RC9	Direct Connection
48	DIM:041	RP73/PCI20/RD9	Direct Connection
49	DIM:108	RP72/SDO2/PCI19/RD8	Direct Connection
50	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
51	DIM:057 to DIM:60, DIM:113 to DIM:116	Vdd	Digital Power (Vcc)
52	DIM:070	RP71/PMD15/RD7	Direct Connection
53	DIM:068	RP70/PMD14/RD6	Direct Connection
54	DIM:066	RP69/PMA15/PMCS2/RD5	Direct Connection
55	DIM:049 (PGD)	PGD3/RP37/SDA2/PMA14/PMCS1/PSCS/RB5	Direct Connection; PGD connected to Pin 4 of Connector J2
56	DIM:051 (PGC)	PGC3/RP38/SCL2/RB6	Direct Connection; PGC connected to Pin 5 of Connector J2
57	DIM:034	RE10	Direct Connection
58	DIM:012	TDO/AN2/CMP3A/RP39/SDA3/RB7	Connected via 0R resistor (R23)
	DIM:105		Can be connected via 0R resistor (R26)
59	DIM:036	RE11	Direct Connection

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TABLE 2: PIN MAPPING – dsPIC33CK256MP508 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	DIM Pin #	dsPIC33CK256MP508 Pin Functional Description	Remarks
60	DIM:009	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
61	DIM:011	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
62	DIM:030	RE12	Direct Connection
63	DIM:042	RP52/PWM5H/ASDA2/RC4	Direct Connection
64	DIM:032	RE13	Direct Connection
65	DIM:044	RP53/PWM5L/ASCL2/PMWR/PMENB/PSWR/RC5	Direct Connection
66	DIM:102	RP58/PWM7H/PMRD/PMWR/PSRD/RC10	Direct Connection
67	DIM:104	RP59/PWM7L/RC11	Direct Connection
68	DIM:098	RP68/ASDA3/RD4	Direct Connection
69	DIM:100	RP67/ASCL3/RD3	Direct Connection
70	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
71	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (Vcc)
72	DIM:046	RP66/RD2	Direct Connection
73	DIM:006	RP65/PWM4H/RD1	Direct Connection
74	DIM:008	RP64/PWM4L/PMD0/RD0	Direct Connection
75	DIM:002	TMS/RP42/PWM3H/PMD1/RB10	Direct Connection
76	DIM:004	TCK/RP43/PWM3L/PMD2/RB11	Direct Connection
77	DIM:086	RE14	Direct Connection
78	DIM:005	TDI/RP44/PWM2H/PMD3/RB12	Direct Connection
79	DIM:088	RE15	Direct Connection
80	DIM:007	RP45/PWM2L/PMD4/RB13	Direct Connection

dsPIC33CK256MP508

Table 3 provides pin mapping from the DIM interface connector to the 80-pin dsPIC33CK256MP508 device.

TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK256MP508 (SORTED BY DIM PIN NUMBER)

DIM Pin #	Device Pin #	dsPIC33CK256MP508 Pin Functional Description	Remarks
DIM:001	1	RP46/PWM1H/PMD5/RB14	Direct Connection
DIM:002	75	TMS/RP42/PWM3H/PMD1/RB10	Direct Connection
DIM:003	3	RP47/PWM1L/PMD6/RB15	Direct Connection
DIM:004	76	TCK/RP43/PWM3L/PMD2/RB11	Direct Connection
DIM:005	78	TDI/RP44/PWM2H/PMD3/RB12	Direct Connection
DIM:006	73	RP65/PWM4H/RD1	Direct Connection
DIM:007	80	RP45/PWM2L/PMD4/RB13	Direct Connection
DIM:008	74	RP64/PWM4L/PMD0/RD0	Direct Connection
DIM:009	60	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
DIM:010	16	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Can be connected via 0R resistor (R5)
DIM:011	61	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
DIM:012	58	TDO/AN2/CMP3A/RP39/SDA3/RB7	Connected via 0R resistor (R23)
DIM:013	45	PGC2/OA2IN+/RP36/RB4	Op Amp 2 Positive Input
DIM:014	—	—	Not Connected
DIM:015	43	PGD2/OA2IN-/AN8/RP35/RB3	Op Amp 2 Negative Input
DIM:016	—	—	Not Connected
DIM:017	41	OA2OUT/AN1/AN7/ANA0/CMP1D/CMP2D/ CMP3D/RP34/SCL3/INT0/RB2	Output of Internal Op Amp 2 if: • Configured and Enabled Op Amp 2 • Populated R9 • Removed R6
DIM:018	—	—	Not Connected
DIM:019	41	OA2OUT/AN1/AN7/ANA0/CMP1D/CMP2D/ CMP3D/RP34/SCL3/INT0/RB2	Can be connected via 0R resistor (R6)
DIM:020	40	AN16/ISRC2/RP55/PMD8/PMA8/RC7	Direct Connection
DIM:021	29	OA3IN+/AN14/CMP2B/ISRC1/RP50/PMD13/ PMA13/RC2	Op Amp 3 Positive Input
DIM:022	15	AN12/ANN0/RP48/RC0	Direct Connection
DIM:023	28	OA3IN-/AN13/CMP1B/ISRC0/RP49/PMA7/RC1	Op Amp 3 Negative Input
DIM:024	38	AN18/CMP3C/ISRC3/RP74/PMD9/PMA9/RD10	Direct Connection
DIM:025	23	OA3OUT/AN4/CMP3B/IBIAS3/RA4	Output of Internal Op Amp 3 if: • Configured and Enabled Op Amp 3 • Populated R29 • Removed R25
DIM:026	36	AN19/CMP2C/RP75/PMA0/PMALL/PSA0/RD11	Connected via 0R resistor (R32)
DIM:027	23	OA3OUT/AN4/CMP3B/IBIAS3/RA4	Can be connected via 0R resistor (R25)
DIM:028	30	AN17/ANN1/IBIAS1/RP54/PMD12/PMA12/RC6	Direct Connection
DIM:029	20	OA1IN+/AN9/PMA6/RA2	Op Amp 1 Positive Input
DIM:030	62	RE12	Direct Connection
DIM:031	18	OA1IN-/ANA1/RA1	Op Amp 1 Negative Input
DIM:032	64	RE13	Direct Connection
DIM:033	16	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Output of Internal Op Amp 1 if: • Configured and Enabled Op Amp 1 • Populated R14 • Removed R5, R7 and R10
DIM:034	57	RE10	Direct Connection
DIM:035	16	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Can be connected via 0R resistor (R10)
	21	DACOUT/AN3/CMP1C/RA3	Connected through filter R1 and C1

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TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK256MP508 (SORTED BY DIM PIN NUMBER) (CONTINUED)

DIM Pin #	Device Pin #	dsPIC33CK256MP508 Pin Functional Description	Remarks
DIM:036	59	RE11	Direct Connection
DIM:037	—	—	VREF (+1.65V) Input from Motor Control Board
DIM:038	24	RE5	Can be connected via 0R resistor (R27)
DIM:039	33	AN15/CMP2A/IBIAS2/RP51/PMD11/PMA11/RC3	Direct Connection
DIM:040	27	RP76/RD12	Connected via 0R resistor (R37)
DIM:041	48	RP73/PCI20/RD9	Direct Connection
DIM:042	63	RP52/PWM5H/ASDA2/RC4	Direct Connection
DIM:043	—	—	Not Connected
DIM:044	65	RP53/PWM5L/ASCL2/PMWR/PMENB/PSWR/RC5	Direct Connection
DIM:045	39	RE7	Connected via 0R resistor (R39)
DIM:046	72	RP66/RD2	Direct Connection
DIM:047	9	$\overline{\text{MCLR}}$	Direct Connection ($\overline{\text{MCLR}}$)
DIM:048	—	—	Not Connected
DIM:049	55	PGD3/RP37/SDA2/PMA14/PMCS1/PSCS/RB5	Direct Connection (PGD)
DIM:050	—	—	Not Connected
DIM:051	56	PGC3/RP38/SCL2/RB6	Direct Connection (PGC)
DIM:052	13	RP78/PCI21/RD14	Direct Connection
DIM:053	—	—	Not Connected
DIM:054	14	ANN2/RP77/RD13	Direct Connection
DIM:055	—	—	VCC_SELECT – Signal to indicate microcontroller supply; If VCC_SELECT = HIGH, then 5V microcontroller; If VCC_SELECT = LOW, then 3.3V microcontroller
DIM:056	42	RE8	This pin is also connected to a general purpose LED LD2 on the DIM
DIM:057	12, 31, 51, 71	VDD	Digital Power (Vcc)
DIM:058			
DIM:059			
DIM:060			
DIM:061	11, 32, 50, 70	Vss	Digital Ground (Vss)
DIM:062			
DIM:063			
DIM:064			
DIM:065	24	RE5	Connected via 0R resistor (R24)
DIM:066	54	RP69/PMA15/PMCS2/RD5	Direct Connection
DIM:067	27	RP76/RD12	Can be connected via 0R resistor (R38)
DIM:068	53	RP70/PMD14/RD6	Direct Connection
DIM:069	—	—	Not Connected
DIM:070	52	RP71/PMD15/RD7	Direct Connection
DIM:071	35	OSCO/CLKO/AN6/RP33/PMA1/PMALH/PSA1/RB1	Direct Connection
DIM:072	—	—	Not Connected
DIM:073	—	—	Not Connected
DIM:074	—	—	Not Connected
DIM:075	—	—	Not Connected
DIM:076	—	—	Not Connected
DIM:077	—	—	Not Connected

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TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK256MP508 (SORTED BY DIM PIN NUMBER) (CONTINUED)

DIM Pin #	Device Pin #	dsPIC33CK256MP508 Pin Functional Description	Remarks
DIM:078	—	—	Not Connected
DIM:079	—	—	Not Connected
DIM:080	10	RP79/PCI22/PMA2/RD15	Direct Connection
DIM:081	17	AN22/RE2	Direct Connection
DIM:082	2	AN20/RE0	Direct Connection
DIM:083	19	AN23/RE3	Direct Connection
DIM:084	4	AN21/RE1	Direct Connection
DIM:085	37	RE6	Direct Connection
DIM:086	77	RE14	Direct Connection
DIM:087	39	RE7	Can be connected via 0R resistor (R40)
DIM:088	79	RE15	Direct Connection
DIM:089	7	RP62/PWM6H/PMA4/RC14	Direct Connection
DIM:090	8	RP63/PWM6L/PMA3/RC15	Direct Connection
DIM:091	5	RP60/PWM8H/PMD7/RC12	Direct Connection
DIM:092	6	RP61/PWM8L/PMA5/RC13	Direct Connection
DIM:093	—	—	Not Connected
DIM:094	36	AN19/CMP2C/RP75/PMA0/PMALL/PSA0/RD11	Can be connected via 0R resistor (R33)
DIM:095	16	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Can be connected via 0R resistor (R7)
DIM:096	22	RE4	Direct Connection
DIM:097	—	—	Not Connected
DIM:098	68	RP68/ASDA3/RD4	Direct Connection
DIM:099	—	—	Not Connected
DIM:100	69	RP67/ASCL3/RD3	Direct Connection
DIM:101	—	—	Not Connected
DIM:102	66	RP58/PWM7H/PMRD/PMWR/PSRD/RC10	Direct Connection
DIM:103	—	—	Not Connected
DIM:104	67	RP59/PWM7L/RC11	Direct Connection
DIM:105	58	TDO/AN2/CMP3A/RP39/SDA3/RB7	Can be connected via 0R resistor (R26)
DIM:106	44	RE9	Direct Connection
DIM:107	—	—	Not Connected
DIM:108	49	RP72/SDO2/PCI19/RD8	Direct Connection
DIM:109	—	—	Not Connected
DIM:110	47	RP57/ASCL1/SDI2/RC9	Direct Connection
DIM:111	—	—	Not Connected
DIM:112	46	RP56/ASDA1/SCK2/RC8	Direct Connection
DIM:113	12, 31, 51, 71	V _{DD}	Digital Power (V _{CC})
DIM:114			
DIM:115			
DIM:116			
DIM:117	11, 32, 50, 70	V _{SS}	Digital Ground (V _{SS})
DIM:118			
DIM:119			
DIM:120			

dsPIC33CK256MP508

INTERNAL AMPLIFIER

Operational amplifiers internal to the dsPIC33CK256MP508 can be configured and enabled for amplifying motor currents. The amplifier circuits are shown in Figure 2. The detailed schematics of the block, “Filter, Feedback and Bias Circuit” used in Figure 2, are shown in Figure 3.

FIGURE 2: dsPIC® DSC INTERNAL AMPLIFIERS

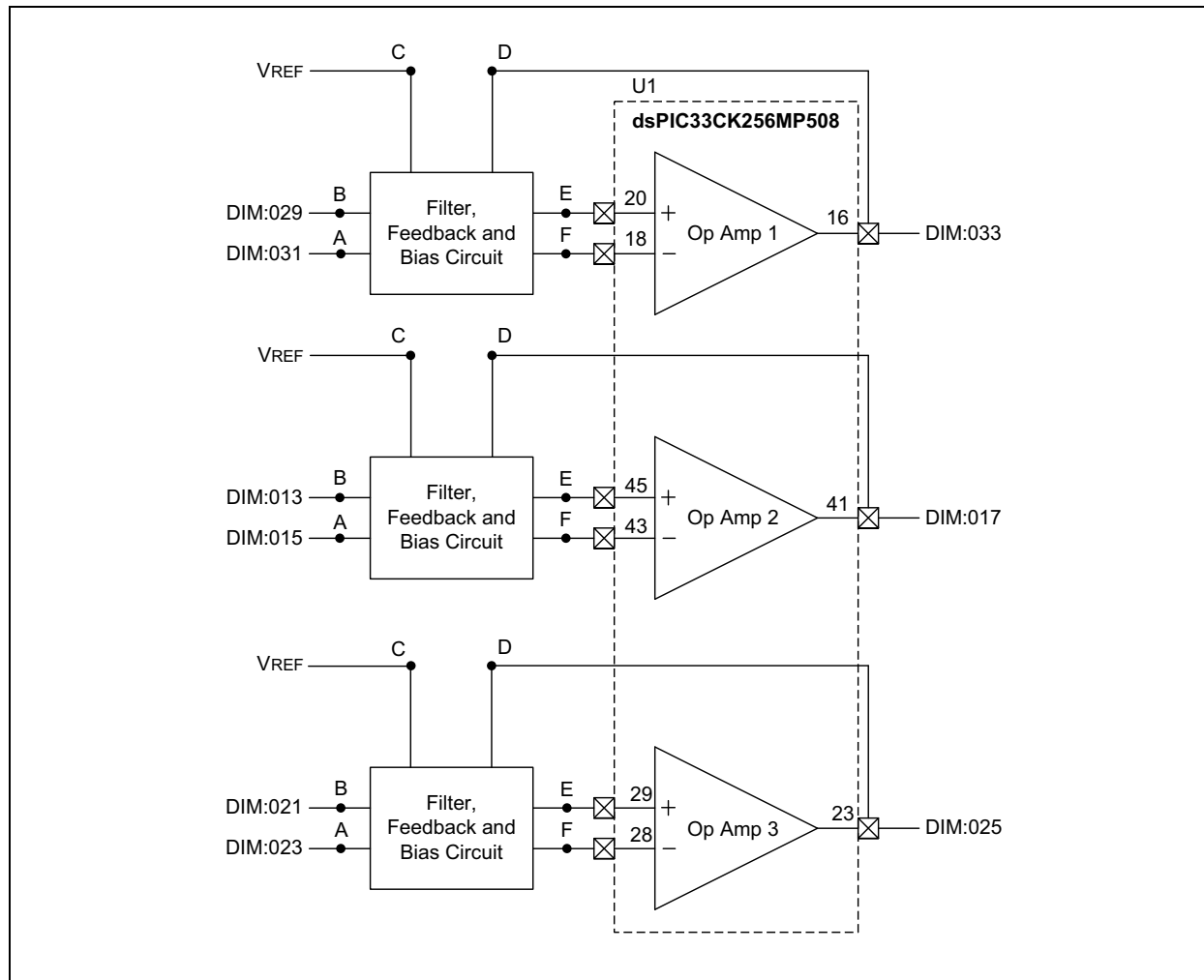
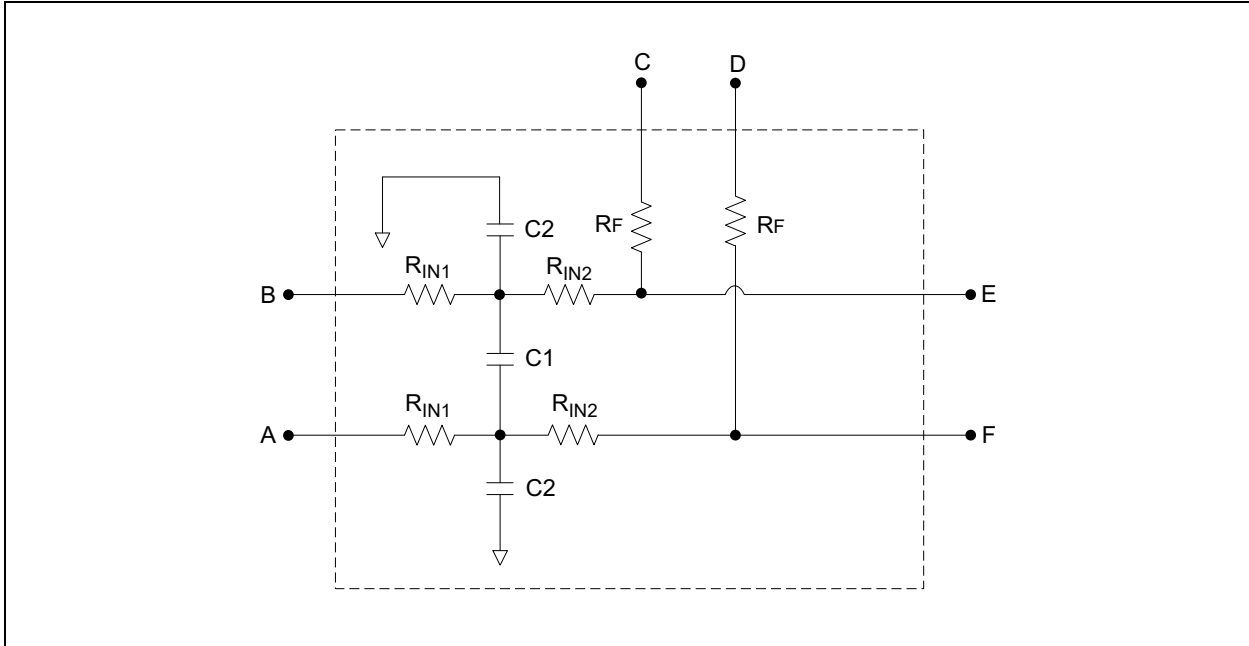


FIGURE 3: FILTER, FEEDBACK AND BIAS CIRCUIT



Equation 1 provides the amplifier gain calculations. Equation 2 and Equation 3 provide the equations to calculate cutoff frequencies of the Differential-mode and Common-mode filters.

EQUATION 1: AMPLIFIER GAIN

$$\text{Differential Amplifier Gain} = \frac{R_f}{(R_{IN1} + R_{IN2})}$$

EQUATION 2: CUTOFF FREQUENCY DIFFERENTIAL-MODE FILTER

$$\text{Differential-mode } f_{-3 \text{ dB}} \cong \frac{1}{2\pi(R_{IN1} + R_{IN2})\left(\frac{C2}{2} + C1\right)}$$

EQUATION 3: CUTOFF FREQUENCY COMMON-MODE FILTER

$$\text{Common-mode } f_{-3 \text{ dB}} \cong \frac{1}{2\pi(R_{IN1})(C2)}$$

dsPIC33CK256MP508

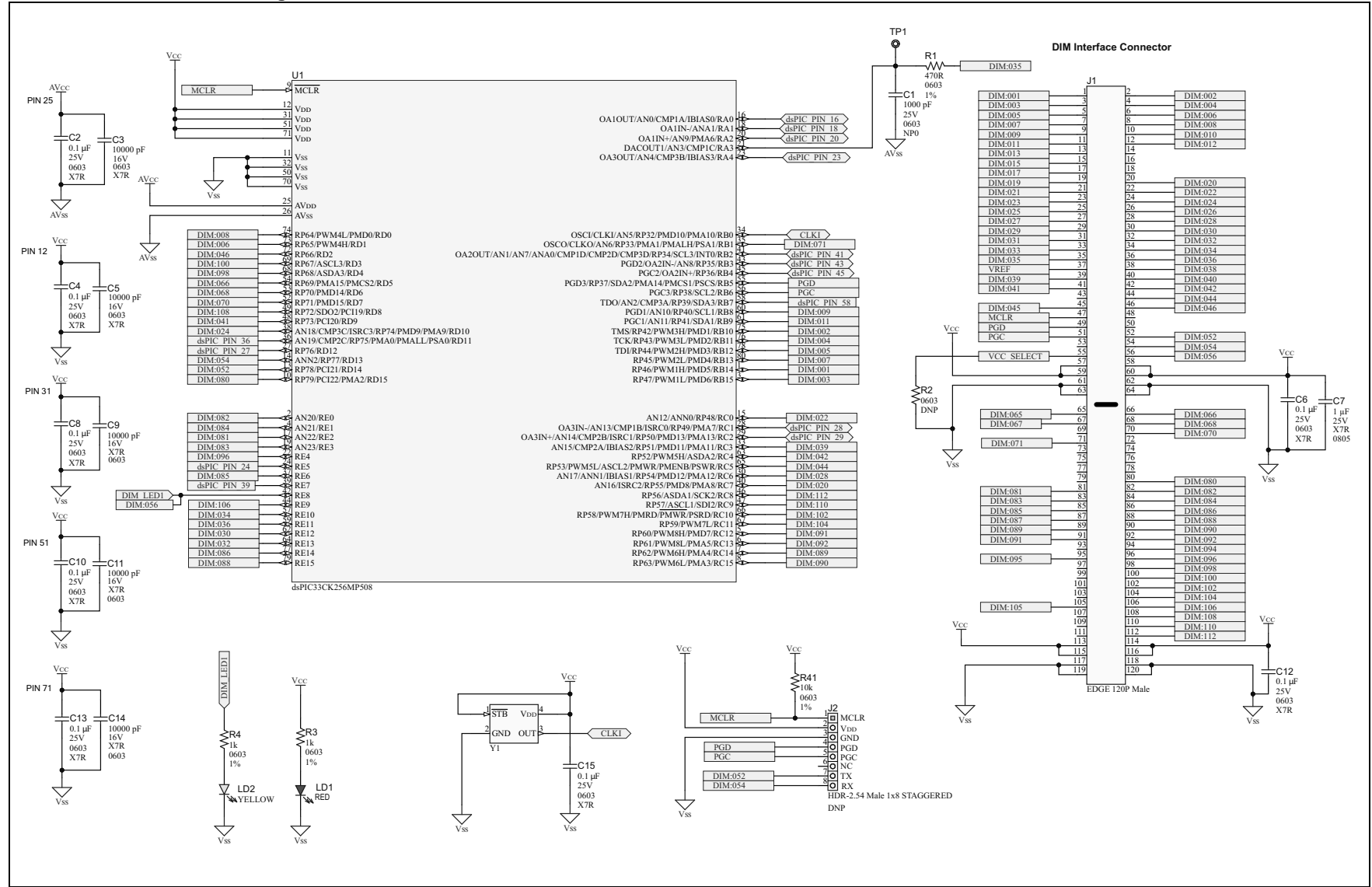
Table 4 summarizes the amplifier gain and filter cutoff frequencies for the amplifier circuit used in the DIM. The customer can select different values, based on application requirements, ensuring peak current is within the operating range of the Motor Control Board in which the DIM is inserted.

TABLE 4: AMPLIFIER GAIN AND CUTOFF FREQUENCIES

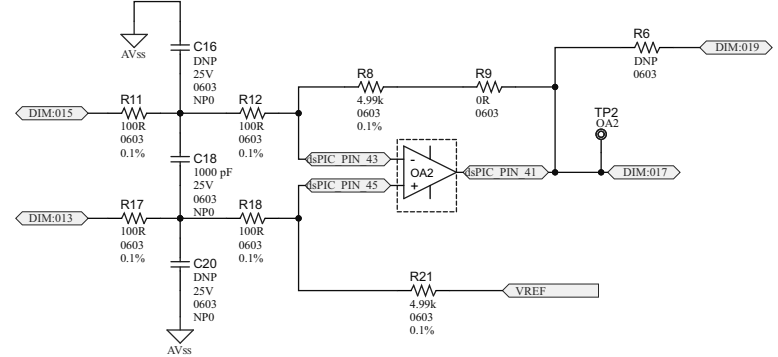
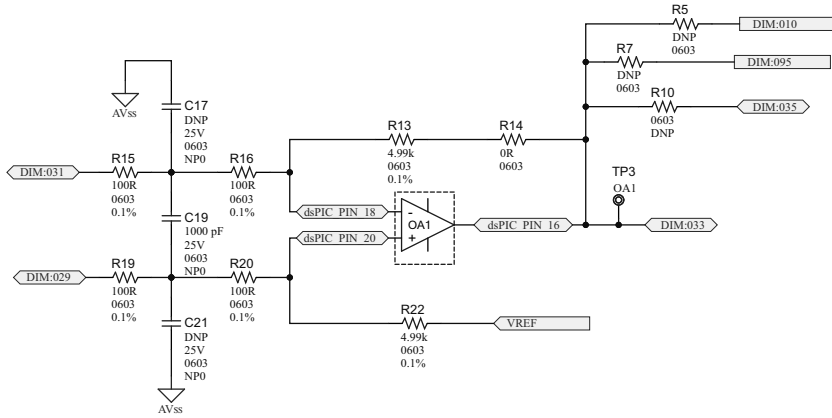
Component Values					Amplifier Gain	Differential-Mode Filter Cutoff Frequency	Common-Mode Filter Cutoff Frequency
R _{IN1}	R _{IN2}	R _F	C1	C2			
100Ω	100Ω	4.99 kΩ	1000 pF	Not Populated	24.95	796 kHz	—

dsPIC33CK256MP508 Motor Control Dual In-Line Module (DIM)

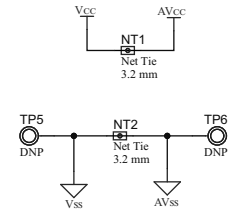
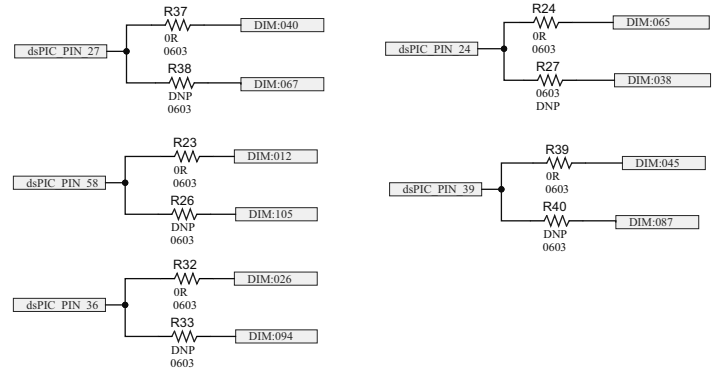
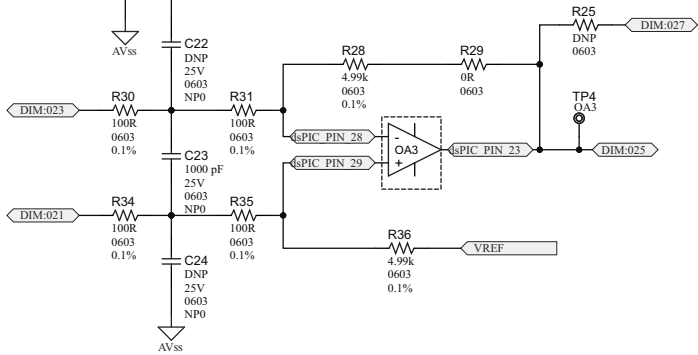
Schematic Revision 3.0, Page 1 of 2



Internal Amplifier Circuit



Jumper Resistors



Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
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