

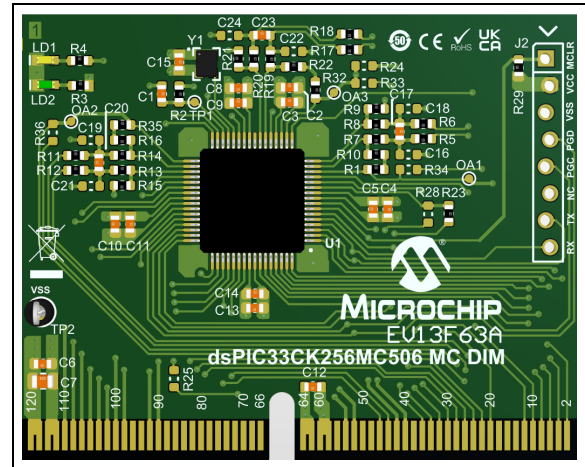
dsPIC33CK256MC506 Motor Control Dual In-Line Module (DIM) Information Sheet

The dsPIC33CK256MC506 Motor Control DIM (P/N: EV13F63A) is designed to demonstrate the motor control capabilities of the dsPIC33CK256MC506 device. This dsPIC® DSC features a 100 MIPS, single-core 16-bit Digital Signal Controller (DSC) with enhanced on-chip peripherals.

This motor control DIM is designed to take advantage of the high-speed PWM module, 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. Table 1 provides information on the hardware versions of the motor control boards that are compatible with this DIM. 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).

FIGURE 1: dsPIC33CK256MC506 MOTOR CONTROL DIM (P/N: EV13F63A)



The 8-pin header J2 is provided for interfacing the programmer/debugger. An 8-pin connector is included with the DIM. This connector can be inserted when needed. Alternatively, any 8-pin, single row, 0.100" (2.54 mm) pitch, unshrouded male header can be used (example, P/N: 6130081121).

The LED LD2 indicates the power-on status of the DIM. A general purpose LED LD1 is provided on the board for debug purposes. The clock for the dsPIC DSC is generated by the MEMS Oscillator (Y1 – DSC6011-JI2B-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 a High-Voltage Development Board. Failure to heed this warning could result in hardware damage.

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Table 2 provides pin mapping from the 64-pin dsPIC33CK256MC506 device to the DIM interface connector.

TABLE 2: PIN MAPPING – dsPIC33CK256MC506 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER)

Device Pin #	DIM Pin #	dsPIC33CK256MC506 Pin Function	Remarks
1	DIM:001	RP46/PWM1H/RB14	Direct Connection
2	DIM:003	RP47/PWM1L/RB15	Direct Connection
3	DIM:052	RP60/RC12	Direct Connection; also directly connected to Pin 7 of Header J2
4	DIM:054	RP61/RC13	Direct Connection; also directly connected to Pin 8 of Header J2
5	DIM:034	RP62/RC14	Direct Connection
6	DIM:036	RP63/RC15	Direct Connection
7	DIM:047 (MCLR)	MCLR	Direct Connection; also directly connected to Pin 1 of Header J2
8	DIM:040	RP79/PCI22/RD15	Direct Connection
9	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
10	DIM:057 to DIM:060, DIM:113 to DIM:116	Vdd	Digital Power (Vcc)
11	DIM:041	RP78/PCI21/RD14	Connected via a 0R (R23) resistor
	DIM:043		Can be connected via a 0R (R28) resistor
12	DIM:030	ANN0/RP77/RD13	Direct Connection
13	DIM:010	AN12/RP48/RC0	Direct Connection
14	DIM:017	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Output of Op Amp 1 (OA1) when configured and enabled; remove resistor R34
	DIM:019		Can be connected via a 0R (R34) resistor; when connecting the signal: • Disable the amplifier Op Amp 1 (OA1) and • Remove resistor R1
15	DIM:015	OA1IN-/AN16/RA1	Op Amp 1 Negative Input – connected via amplifier input resistors
16	DIM:013	OA1N+/AN9/RA2	Op Amp 1 Positive Input – connected via amplifier input resistors
17	DIM:011	DACOUT1/AN3/CMP1C/RA3	Direct Connection
18	DIM:033	OA3OUT/AN4/IBIAS3/RA4	Output of Op Amp 3 (OA3) when configured and enabled; remove resistors R33 and R24
	DIM:035		Can be connected via a 0R (R33) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R24
	DIM:020		Can be connected via a 0R (R24) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R33
19	DIM:057 to DIM:060, DIM:113 to DIM:116	AVDD	Digital Power (Vcc)
20	DIM:061 to DIM:064, DIM:117 to DIM:120	AVss	Digital Ground (Vss)
21	DIM:032	RP76/RD12	Direct Connection
22	DIM:031	OA3IN-/AN13/CMP1B/ISRC0/RP49/RC1	Op Amp 3 Negative Input – connected via amplifier input resistors

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TABLE 2: PIN MAPPING – dsPIC33CK256MC506 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	DIM Pin #	dsPIC33CK256MC506 Pin Function	Remarks
23	DIM:029	OA3IN+/AN14/CMP2B/ISRC1/RP50/RC2	Op Amp 3 Positive Input – connected via amplifier input resistors
24	DIM:024	AN19/IBIAS1/RP54/RC6	Direct Connection
25	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (Vcc)
26	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
27	DIM:012	AN15/CMP2A/IBIAS2/RP51/RC3	Direct Connection
28	—	OSCI/CLKI/AN5/RP32/RB0	CLKI – clock output of MEMS Oscillator (Y1) is connected as input clock of dsPIC® DSC (U1)
29	DIM:071	OSCO/CLKO/AN6/RP33/RB1	Direct Connection
30	DIM:035	CMP2C/RP75/RD11	Connected via an RC (R2, C1) filter
31	DIM:026	AN18/ISRC3/RP74/RD10	Direct Connection
32	DIM:022	AN7/ISRC2/RP55/RC7	Direct Connection
33	DIM:025	OA2OUT/AN1/CMP1D/CMP2D/RP34/INT0/RB2	Output of Op Amp 2 (OA2) when configured and enabled; remove resistor R36
	DIM:027		Can be connected via a 0R (R36) resistor; when connecting the signal: • Disable the amplifier Op Amp 2 (OA2) and • Remove resistor R35
34	DIM:023	PGD2/OA2IN-/AN8/RP35/RB3	Op Amp 2 Negative Input – connected via amplifier input resistors
35	DIM:021	PGC2/OA2IN+/AN17/RP36/RB4	Op Amp 2 Positive Input – connected via amplifier input resistors
36	DIM:098	RP56/ASDA1/SCK2/RC8	Direct Connection
37	DIM:100	RP57/ASCL1/SDI2/RC9	Direct Connection
38	DIM:110	RP73/PCI20/RD9	Direct Connection
39	DIM:112	RP72/SDO2/PCI19/RD8	Direct Connection
40	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
41	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (Vcc)
42	DIM:108	RP71/RD7	Direct Connection
43	DIM:106	RP70/RD6	Direct Connection
44	DIM_LED1	RP69/RD5	This pin is connected to a general-purpose LED (LD1) on the DIM via a resistor R4 (1k).
	DIM:065		Can be connected via a 0R (R25) resistor. Ensure the resistor R4 is removed when populating R25.
45	DIM:049 (PGD)	PGD3/RP37/RB5	Direct Connection; also directly connected to Pin 4 of Header J2
46	DIM:051 (PGC)	PGC3/RP38/RB6	Direct Connection; also directly connected to Pin 5 of Header J2
47	DIM:009	TDO/AN2/RP39/RB7	Direct Connection
48	DIM:039	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
49	DIM:028	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
50	DIM:104	RP52/RC4	Direct Connection
51	DIM:102	RP53/RC5	Direct Connection
52	DIM:092	RP58/RC10	Direct Connection
53	DIM:090	RP59/RC11	Direct Connection

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TABLE 2: PIN MAPPING – dsPIC33CK256MC506 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	DIM Pin #	dsPIC33CK256MC506 Pin Function	Remarks
54	DIM:046	RP68/RD4	Direct Connection
55	DIM:044	RP67/RD3	Direct Connection
56	DIM:061 to DIM:064, DIM:117 to DIM:120	Vss	Digital Ground (Vss)
57	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (Vcc)
58	DIM:042	RP66/RD2	Direct Connection
59	DIM:006	RP65/PWM4H/RD1	Direct Connection
60	DIM:008	RP64/PWM4L/RD0	Direct Connection
61	DIM:002	TMS/RP42/PWM3H/RB10	Direct Connection
62	DIM:004	TCK/RP43/PWM3L/RB11	Direct Connection
63	DIM:005	TDI/RP44/PWM2H/RB12	Direct Connection
64	DIM:007	RP45/PWM2L/RB13	Direct Connection

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Table 3 provides pin mapping from the DIM interface connector to the 64-pin dsPIC33CK256MC506 device.

TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK256MC506 (SORTED BY DIM PIN NUMBER)

DIM Pin #	Device Pin #	dsPIC33CK256MC506 Pin Function	Remarks
DIM:001	1	RP46/PWM1H/RB14	Direct Connection
DIM:002	61	TMS/RP42/PWM3H/RB10	Direct Connection
DIM:003	2	RP47/PWM1L/RB15	Direct Connection
DIM:004	62	TCK/RP43/PWM3L/RB11	Direct Connection
DIM:005	63	TDI/RP44/PWM2H/RB12	Direct Connection
DIM:006	59	RP65/PWM4H/RD1	Direct Connection
DIM:007	64	RP45/PWM2L/RB13	Direct Connection
DIM:008	60	RP64/PWM4L/RD0	Direct Connection
DIM:009	47	TDO/AN2/RP39/RB7	Direct Connection
DIM:010	13	AN12/RP48/RC0	Direct Connection
DIM:011	17	DACOUT1/AN3/CMP1C/RA3	Direct Connection
DIM:012	27	AN15/CMP2A/IBIAS2/RP51/RC3	Direct Connection
DIM:013	16	OA1IN+/AN9/RA2	Op Amp 1 Positive Input – connected via amplifier input resistors
DIM:014	—	—	No Connection
DIM:015	15	OA1IN-/AN16/RA1	Op Amp 1 Negative Input – connected via amplifier input resistors
DIM:016	—	—	No Connection
DIM:017	14	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Output of Op Amp 1 (OA1) when configured and enabled; remove resistor R34
DIM:018	—	—	No Connection
DIM:019	14	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Can be connected via a 0R (R34) resistor; when connecting the signal: • Disable the amplifier Op Amp 1 (OA1) and • Remove resistor R1
DIM:020	18	OA3OUT/AN4/IBIAS3/RA4	Can be connected via a 0R (R24) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R33
DIM:021	35	PGC2/OA2IN+/AN17/RP36/RB4	Op Amp 2 Positive Input – connected via amplifier input resistors
DIM:022	32	AN7/ISRC2/RP55/RC7	Direct Connection
DIM:023	34	PGD2/OA2IN-/AN8/RP35/RB3	Op Amp 2 Negative Input – connected via amplifier input resistors
DIM:024	24	AN19/IBIAS1/RP54/RC6	Direct Connection
DIM:025	33	OA2OUT/AN1/CMP1D/CMP2D/RP34/INT0/RB2	Output of Op Amp 2 (OA2) when configured and enabled; remove resistor R36
DIM:026	31	AN18/ISRC3/RP74/RD10	Direct Connection
DIM:027	33	OA2OUT/AN1/CMP1D/CMP2D/RP34/INT0/RB2	Can be connected via a 0R (R36) resistor; when connecting the signal: • Disable the amplifier Op Amp 2 (OA2) and • Remove resistor R35
DIM:028	49	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
DIM:029	23	OA3IN+/AN14/CMP2B/ISRC1/RP50/RC2	Op Amp 3 Positive Input – connected via amplifier input resistors
DIM:030	12	ANN0/RP77/RD13	Direct Connection

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TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK256MC506 (SORTED BY DIM PIN NUMBER) (CONTINUED)

DIM Pin #	Device Pin #	dsPIC33CK256MC506 Pin Function	Remarks
DIM:031	22	OA3IN-/AN13/CMP1B/ISRC0/RP49/RC1	Op Amp 3 Negative Input – connected via amplifier input resistors
DIM:032	21	RP76/RD12	Direct Connection
DIM:033	18	OA3OUT/AN4/IBIAS3/RA4	Output of Op Amp 3 (OA3) when configured and enabled; remove resistors R33 and R24
DIM:034	5	RP62/RC14	Direct Connection
DIM:035	18	OA3OUT/AN4/IBIAS3/RA4	Can be connected via a 0R (R33) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R24
DIM:035	30	CMP2C/RP75/RD11	Connected via an RC (R2, C1) filter
DIM:036	6	RP63/RC15	Direct Connection
DIM:037 (VREF)	16, 23, 35	Connected to the positive input of amplifiers OA1, OA2 and OA3 through gain resistor	VREF (+1.65V) Input from Motor Control Board
DIM:038	—	—	No Connection
DIM:039	48	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
DIM:040	8	RP79/PCI22/RD15	Direct Connection
DIM:041	11	RP78/PCI21/RD14	Connected via a 0R (R23) resistor
DIM:042	58	RP66/RD2	Direct Connection
DIM:043	11	RP78/PCI21/RD14	Can be connected via a 0R (R28) resistor
DIM:044	55	RP67/RD3	Direct Connection
DIM:045	—	—	No Connection
DIM:046	54	RP68/RD4	Direct Connection
DIM:047 (MCLR)	7	MCLR	Direct Connection; also directly connected to Pin 1 of Header J2
DIM:048	—	—	No Connection
DIM:049 (PGD)	45	PGD3/RP37/RB5	Direct Connection; also directly connected to Pin 4 of Header J2
DIM:050	—	—	No Connection
DIM:051 (PGC)	46	PGC3/RP38/RB6	Direct Connection; also directly connected to Pin 5 of Header J2
DIM:052	3	RP60/RC12	Direct Connection; also directly connected to Pin 7 of Header J2
DIM:053	—	—	No Connection
DIM:054	4	RP61/RC13	Direct Connection; also directly connected to Pin 8 of Header J2
DIM:055 (VCC_SELECT)	—	—	No Connection
DIM:056	—	—	No Connection
DIM:057 to DIM:060	10, 19, 25, 41, 57	VDD	Digital Power (Vcc)
DIM:061 to DIM:064	9, 20, 26, 40, 56	Vss	Digital Ground (Vss)
DIM:065	44	RP69/RD5	Can be connected via a 0R (R25) resistor. Ensure the resistor R4 is removed when populating R25.
DIM:066 to DIM:070	—	—	No Connection
DIM:071	29	OSCO/CLKO/AN6/RP33/RB1	Direct Connection
DIM:072 to DIM:089	—	—	No Connection
DIM:090	53	RP59/RC11	Direct Connection

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TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK256MC506 (SORTED BY DIM PIN NUMBER) (CONTINUED)

DIM Pin #	Device Pin #	dsPIC33CK256MC506 Pin Function	Remarks
DIM:091	—	—	No Connection
DIM:092	52	RP58/RC10	Direct Connection
DIM:093 to DIM:097	—	—	No Connection
DIM:098	36	RP56/ASDA1/SCK2/RC8	Direct Connection
DIM:099	—	—	No Connection
DIM:100	37	RP57/ASCL1/SDI2/RC9	Direct Connection
DIM:101	—	—	No Connection
DIM:102	51	RP53/RC5	Direct Connection
DIM:103	—	—	No Connection
DIM:104	50	RP52/RC4	Direct Connection
DIM:105	—	—	No Connection
DIM:106	43	RP70/RD6	Direct Connection
DIM:107	—	—	No Connection
DIM:108	42	RP71/RD7	Direct Connection
DIM:109	—	—	No Connection
DIM:110	38	RP73/PCI20/RD9	Direct Connection
DIM:111	—	—	No Connection
DIM:112	39	RP72/SDO2/PCI19/RD8	Direct Connection
DIM:113 to DIM:116	10, 19, 25, 41, 57	VDD	Digital Power (Vcc)
DIM:117 to DIM:120	9, 20, 26, 40, 56	Vss	Digital Ground (Vss)

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INTERNAL AMPLIFIER

Operational amplifiers internal to the dsPIC33CK256MC506 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

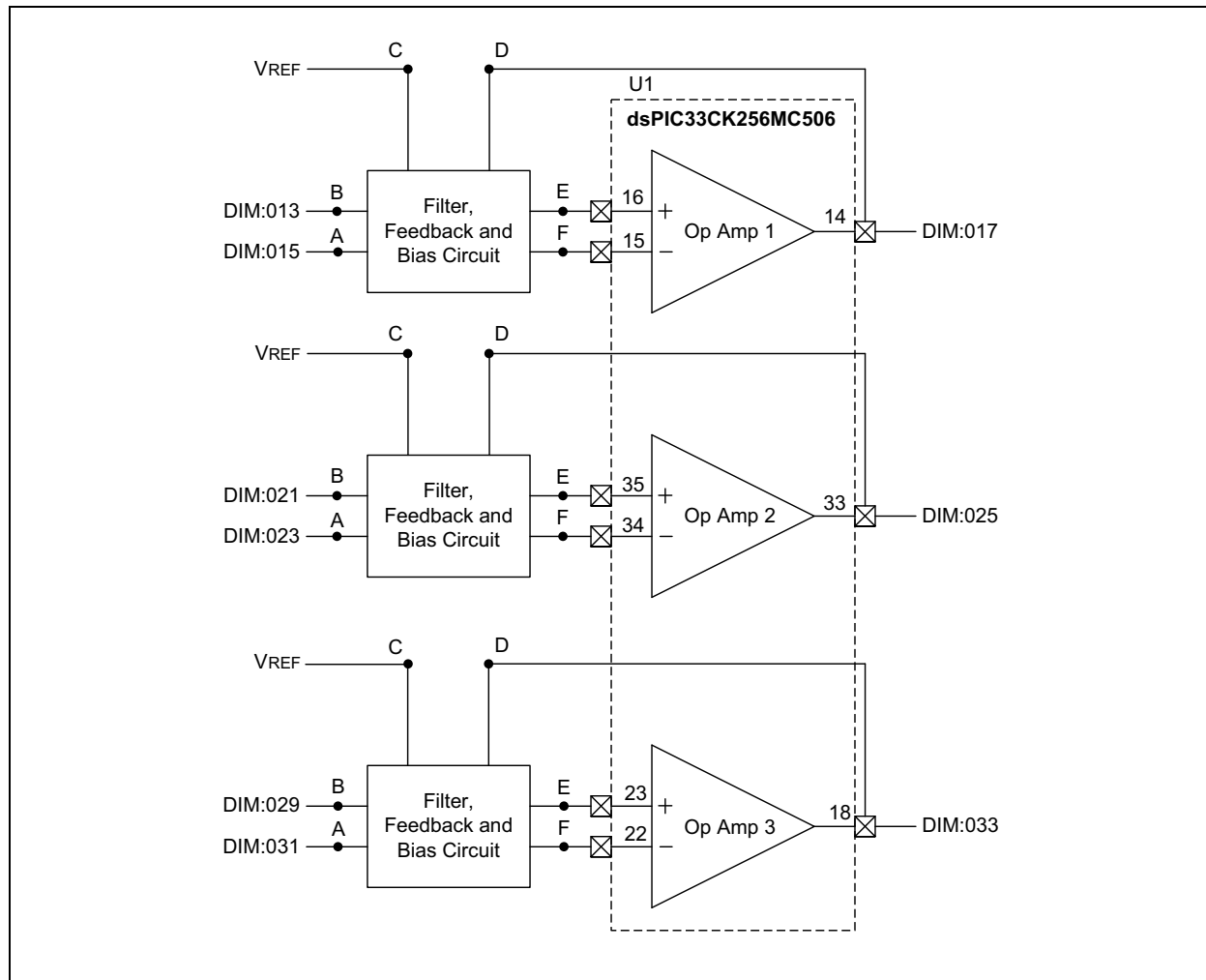
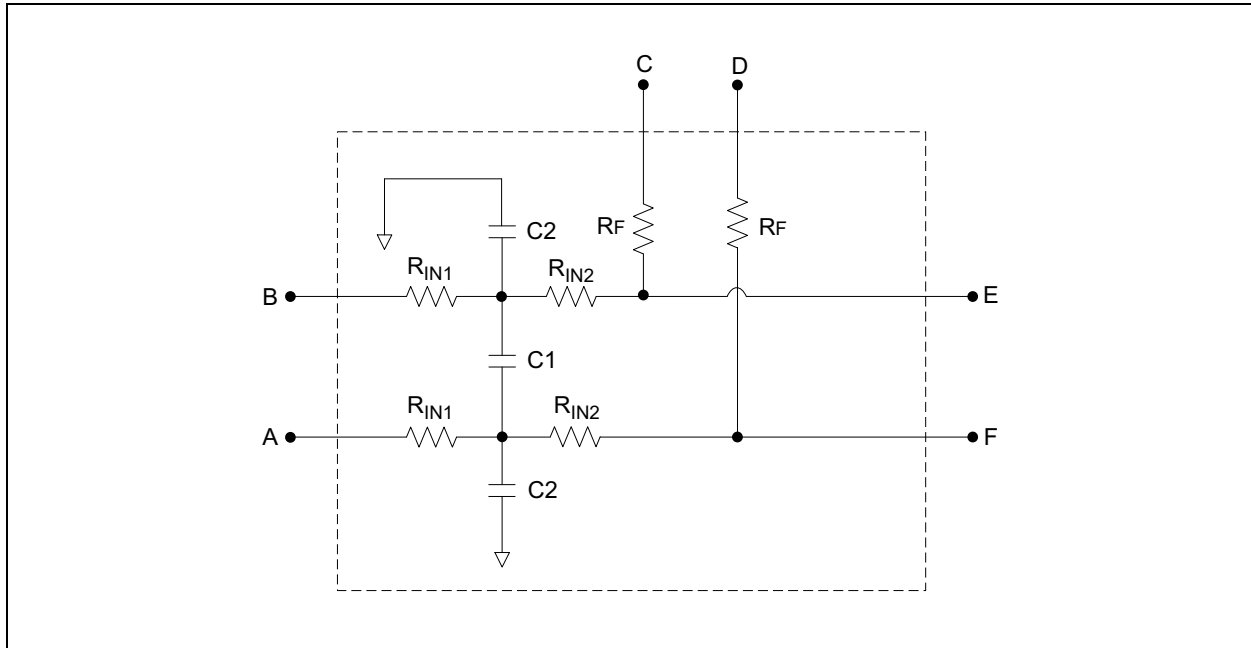


FIGURE 3: FILTER, FEEDBACK AND BIAS CIRCUIT



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

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

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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 the application requirements, ensuring peak current is within the operating range of the Motor Control Board in which the DIM is inserted.

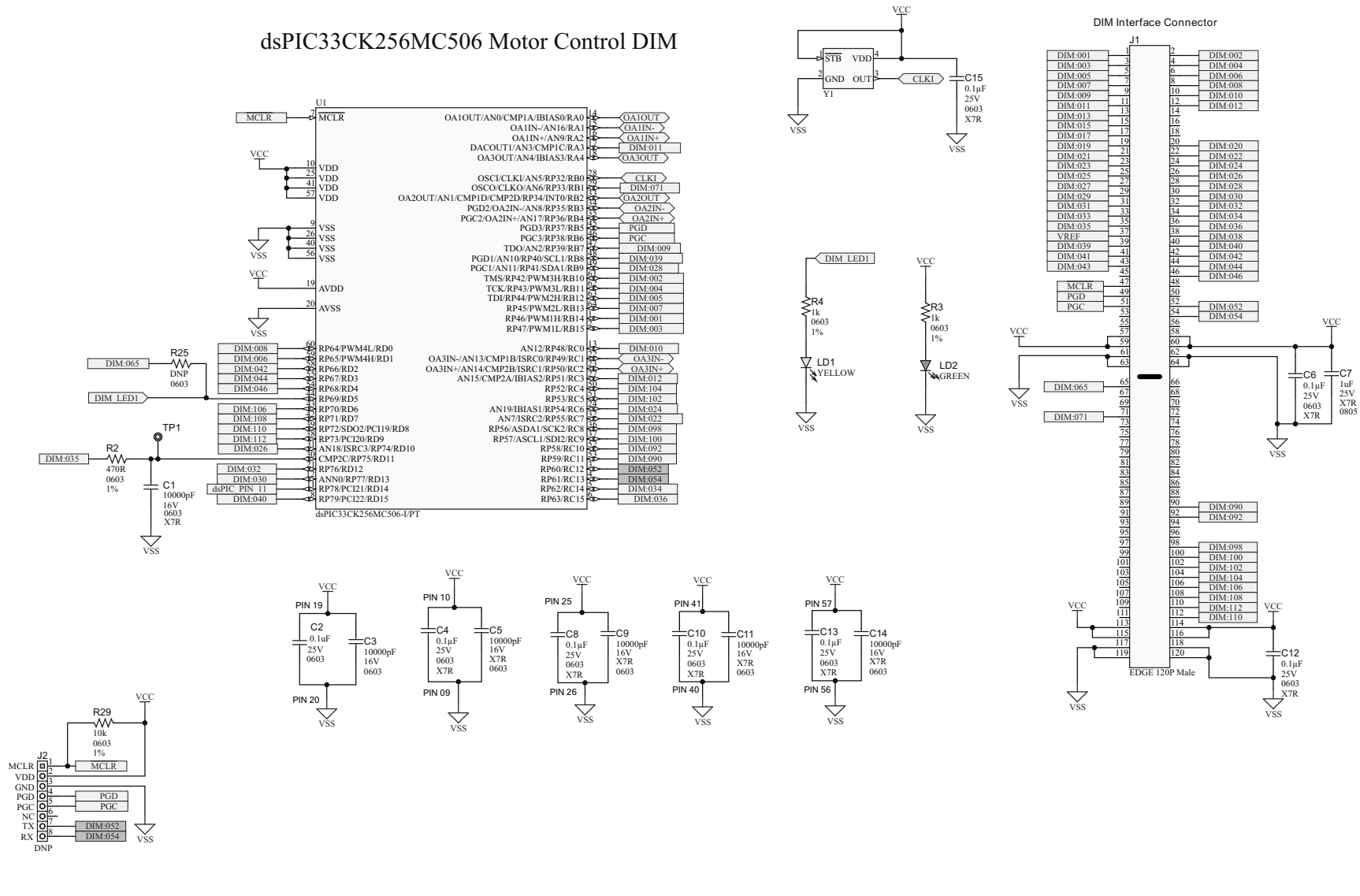
TABLE 4: AMPLIFIER GAIN AND CUTOFF FREQUENCIES

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	—

dsPIC33CK256MC506 Motor Control Dual In-Line Module (DIM)

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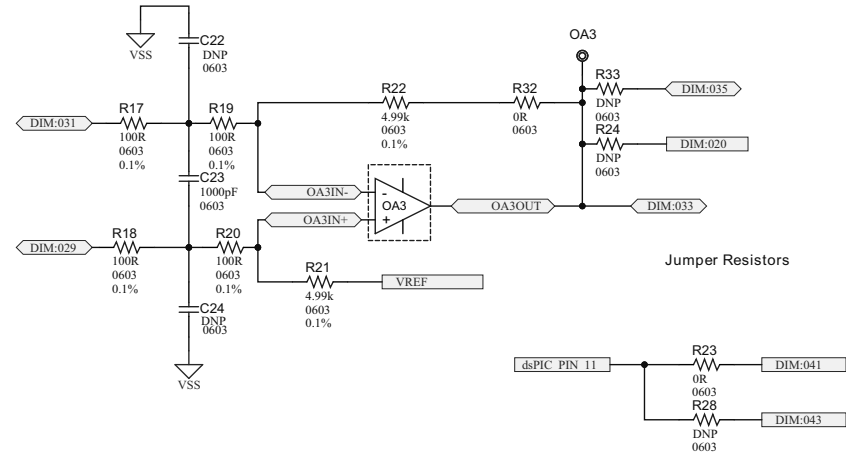
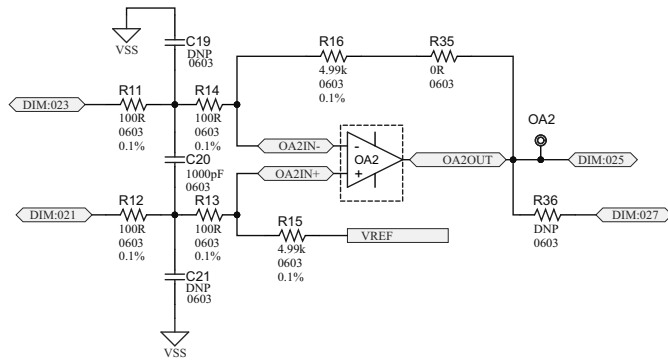
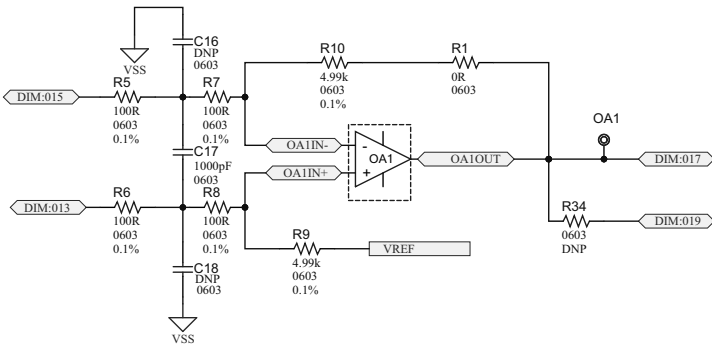
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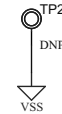
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dsPIC33CK256MC506 Motor Control DIM



The operational amplifiers OA1, OA2, and OA3 are internal to dsPIC33CK256MC506



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