dsPIC33CK64MC105

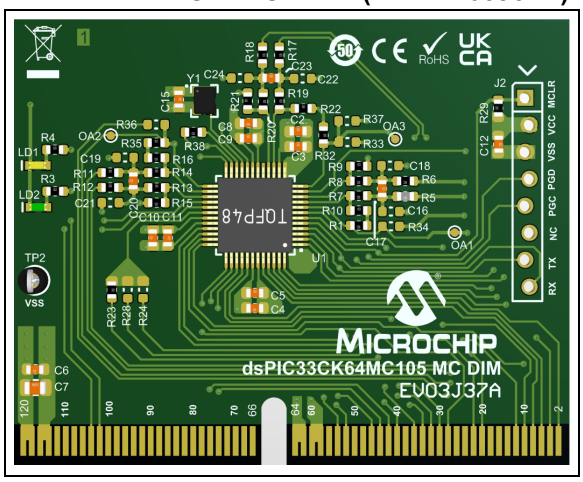
dsPIC33CK64MC105 Motor Control Dual In-Line Module (DIM) Information Sheet

The dsPIC33CK64MC105 Motor Control DIM (P/N: EV03J37A) is designed to demonstrate the motor control capabilities of the dsPIC33CK64MC105 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: dsPIC33CK64MC105 MOTOR CONTROL DIM (P/N: EV03J37A)



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: 61300811121).

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 48-pin dsPIC33CK64MC105 device to the DIM interface connector.

TABLE 2: PIN MAPPING – dsPIC33CK64MC105 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER)

Device Pin #	DIM Pin #	dsPIC33CK64MC105 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:047 ($\overline{MCLR}$)	$\overline{MCLR}$	Direct Connection; also directly connected to Pin 1 of Header J2
6	DIM:036	ANN0/RP77/RD13	Direct Connection
7	DIM:010	AN12/RP48/RC0	Direct Connection
8	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 0R (R34) resistor; when connecting the signal: • Disable the amplifier Op Amp 1 (OA1) and • Remove resistor R1
9	DIM:015	OA1IN-/RA1	Op Amp 1 Negative Input – connected via amplifier input resistors
10	DIM:013	OA1IN+/AN9/RA2	Op Amp 1 Positive Input – connected via amplifier input resistors
11	DIM:011	DACOUT/AN3/CMP1C/RA3	Direct Connection
12	DIM:033	OA3OUT/AN4/IBIAS3/RA4	Output of Op Amp 3 (OA3) when configured and enabled; remove resistors R33 and R37
	DIM:035		Can be connected via 0R (R33) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R37
	DIM:020		Can be connected via 0R (R37) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R33
13	DIM:057 to DIM:060, DIM:113 to DIM:116	AVDD	Digital Power (VCC)
14	DIM:061 to DIM:064, DIM:117 to DIM:120	AVSS	Digital Ground (VSS)
15	DIM:031	OA3IN-/AN13/CMP1B/ISRC0/RP49/RC1	Op Amp 3 Negative Input – connected via amplifier input resistors
16	DIM:029	OAIN+/AN14/ISRC1/RP50/RC2	Op Amp 3 Positive Input – connected via amplifier input resistors
17	DIM:046	IBIAS1/RP54/RC6	Direct Connection
18	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (VCC)
19	DIM:061 to DIM:064, DIM:117 to DIM:120	VSS	Digital Ground (VSS)

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TABLE 2: PIN MAPPING – dsPIC33CK64MC105 TO DIM INTERFACE CONNECTOR (SORTED BY DEVICE PIN NUMBER) (CONTINUED)

Device Pin #	DIM Pin #	dsPIC33CK64MC105 Pin Function	Remarks
20	DIM:012	AN15/IBIAS2/RP51/RC3	Direct Connection
21	—	OSCI/CLKI/AN5/RP32/RB0	CLKI – clock output of MEMS Oscillator (Y1) is connected as input clock of dsPIC® DSC (U1)
22	DIM:022	OSCO/CLKO/AN6/RP33/RB1	Connected via 0R (R38) resistor
23	DIM:030	ISRC3/RP74/RD10	Direct Connection
24	DIM:032	ISRC2/RP55/RC7	Direct Connection; this pin is connected to a general purpose LED (LD1) on the DIM
25	DIM:025	OA2OUT/AN1/AN7/CMP1D/RP34/INT0/RB2	Output of Op Amp 2 (OA2) when configured and enabled; remove resistor R36
	DIM:027		Can be connected via 0R (R36) resistor; when connecting the signal: • Disable the amplifier Op Amp 2 (OA2) and • Remove resistor R35
26	DIM:023	PGD2/OA2IN-/AN8/RP35/RB3	Op Amp 2 Negative Input – connected via amplifier input resistors
27	DIM:021	PGC2/OA2IN+/RP36/RB4	Op Amp 2 Positive Input – connected via amplifier input resistors
28	DIM:102	RP56/ASDA1/SCK2/RC8	Direct Connection
29	DIM:104	RP57/ASCL1/SDI2/RC9	Direct Connection
30	DIM:040	RP72/SDO2/PCI19/RD8	Connected via 0R (R23) resistor
	DIM:041		Can be connected via 0R (R24) resistor
	DIM:043		Can be connected via 0R (R28) resistor
31	DIM:061 to DIM:064, DIM:117 to DIM:120	VSS	Digital Ground (VSS)
32	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (VCC)
33	DIM:049 (PGD)	PGD3/RP37/RB5	Direct Connection; also directly connected to Pin 4 of Header J2
34	DIM:051 (PGC)	PGC3/RP38/RB6	Direct Connection; also directly connected to Pin 5 of Header J2
35	DIM:009	TDO/AN2/RP39/RB7	Direct Connection
36	DIM:039	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
37	DIM:028	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
38	DIM:042	RP52/RC4	Direct Connection
39	DIM:044	RP53/RC5	Direct Connection
40	DIM:034	RP58/RC10	Direct Connection
41	DIM:008	RP59/RC11	Direct Connection
42	DIM:061 to DIM:064, DIM:117 to DIM:120	VSS	Digital Ground (VSS)
43	DIM:057 to DIM:060, DIM:113 to DIM:116	VDD	Digital Power (VCC)
44	DIM:006	RP65/PWM4H/RD1	Direct Connection
45	DIM:002	TMS/RP42/PWM3H/RB10	Direct Connection
46	DIM:004	TCK/RP43/PWM3L/RB11	Direct Connection
47	DIM:005	TDI/RP44/PWM2H/RB12	Direct Connection
48	DIM:007	RP45/PWM2L/RB13	Direct Connection

Table 3 provides pin mapping from the DIM interface connector to the 48-pin dsPIC33CK64MC105 device.

TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK64MC105 (SORTED BY DIM PIN NUMBER)

DIM Pin #	Device Pin #	dsPIC33CK64MC105 Pin Function	Remarks
DIM:001	1	RP46/PWM1H/RB14	Direct Connection
DIM:002	45	TMS/RP42/PWM3H/RB10	Direct Connection
DIM:003	2	RP47/PWM1L/RB15	Direct Connection
DIM:004	46	TCK/RP43/PWM3L/RB11	Direct Connection
DIM:005	47	TDI/RP44/PWM2H/RB12	Direct Connection
DIM:006	44	RP65/PWM4H/RD1	Direct Connection
DIM:007	48	RP45/PWM2L/RB13	Direct Connection
DIM:008	41	RP59/RC11	Direct Connection
DIM:009	35	TDO/AN2/RP39/RB7	Direct Connection
DIM:010	7	AN12/RP48/RC0	Direct Connection
DIM:011	11	DACOUT/AN3/CMP1C/RA3	Direct Connection
DIM:012	20	AN15/IBIAS2/RP51/RC3	Direct Connection
DIM:013	10	OA1IN+/AN9/RA2	Op Amp 1 Positive Input – connected via amplifier input resistors
DIM:014	—	—	No Connection
DIM:015	9	OA1IN-/RA1	Op Amp 1 Negative Input – connected via amplifier input resistors
DIM:016	—	—	No Connection
DIM:017	8	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Output of Op Amp 1 (OA1) when configured and enabled; remove resistor R34
DIM:018	—	—	No Connection
DIM:019	8	OA1OUT/AN0/CMP1A/IBIAS0/RA0	Can be connected via 0R (R34) resistor; when connecting the signal: • Disable the amplifier Op Amp 1 (OA1) and • Remove resistor R1
DIM:020	12	OA3OUT/AN4/IBIAS3/RA4	Can be connected via 0R (R37) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R33
DIM:021	27	PGC2/OA2IN+/RP36/RB4	Op Amp 2 Positive Input – connected via amplifier input resistors
DIM:022	22	OSCO/CLKO/AN6/RP33/RB1	Connected via 0R (R38) resistor
DIM:023	26	PGD2/OA2IN-/AN8/RP35/RB3	Op Amp 2 Negative Input – connected via amplifier input resistors
DIM:024	—	—	No Connection
DIM:025	25	OA2OUT/AN1/AN7/CMP1D/RP34/INT0/RB2	Output of Op Amp 2 (OA2) when configured and enabled; remove resistor R36
DIM:026	—	—	No Connection
DIM:027	25	OA2OUT/AN1/AN7/CMP1D/RP34/INT0/RB2	Can be connected via 0R (R36) resistor; when connecting the signal: • Disable the amplifier Op Amp 2 (OA2) and • Remove resistor R35
DIM:028	37	PGC1/AN11/RP41/SDA1/RB9	Direct Connection
DIM:029	16	OA3IN+/AN14/ISRC1/RP50/RC2	Op Amp 3 Positive Input – connected via amplifier input resistors

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TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK64MC105 (SORTED BY DIM PIN NUMBER) (CONTINUED)

DIM Pin #	Device Pin #	dsPIC33CK64MC105 Pin Function	Remarks
DIM:030	23	ISRC3/RP74/RD10	Direct Connection
DIM:031	15	OA3IN-/AN13/CMP1B/ISRC0/RP49/RC1	Op Amp 3 Negative Input – connected via amplifier input resistors
DIM:032	24	ISRC2/RP55/RC7	Direct Connection; also, this pin is connected to a general purpose LED (LD1) on the DIM
DIM:033	12	OA3OUT/AN4/IBIAS3/RA4	Output of Op Amp 3 (OA3) when configured and enabled; remove resistors R33 and R37
DIM:034	40	RP58/RC10	Direct Connection
DIM:035	12	OA3OUT/AN4/IBIAS3/RA4	Can be connected via 0R (R33) resistor; when connecting the signal: • Disable the amplifier Op Amp 3 (OA3) and • Remove resistors R32 and R37
DIM:036	6	ANN0/RP77/RD13	Direct Connection
DIM:037 (V_{REF})	10, 16, 27	Connected to the positive input of amplifiers OA1, OA2 and OA3 through gain resistor	V_{REF} (+1.65V) Input from Motor Control Board
DIM:038	—	—	No Connection
DIM:039	36	PGD1/AN10/RP40/SCL1/RB8	Direct Connection
DIM:040	30	RP72/SDO2/PCI19/RD8	Connected via 0R (R23) resistor
DIM:041	30	RP72/SDO2/PCI19/RD8	Can be connected via 0R (R24) resistor
DIM:042	38	RP52/RC4	Direct Connection
DIM:043	30	RP72/SDO2/PCI19/RD8	Can be connected via 0R (R28) resistor
DIM:044	39	RP53/RC5	Direct Connection
DIM:045	—	—	No Connection
DIM:046	17	IBIAS1/RP54/RC6	Direct Connection
DIM:047 ($\overline{MCLR}$)	5	$\overline{MCLR}$	Direct Connection; also directly connected to Pin 1 of Header J2
DIM:048	—	—	No Connection
DIM:049 (PGD)	33	PGD3/RP37/RB5	Direct Connection; also directly connected to Pin 4 of Header J2
DIM:050	—	—	No Connection
DIM:051 (PGC)	34	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	13, 18, 32, 43	V_{DD}	Digital Power (V_{CC})
DIM:061 to DIM:064	14, 19, 31, 42	V_{SS}	Digital Ground (V_{SS})
DIM:065 to DIM:101	—	—	No Connection
DIM:102	28	RP56/ASDA1/SCK2/RC8	Direct Connection
DIM:103	—	—	No Connection
DIM:104	29	RP57/ASCL1/SDI2/RC9	Direct Connection
DIM:105 to DIM:112	—	—	No Connection

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TABLE 3: PIN MAPPING – DIM INTERFACE CONNECTOR TO dsPIC33CK64MC105 (SORTED BY DIM PIN NUMBER) (CONTINUED)

DIM Pin #	Device Pin #	dsPIC33CK64MC105 Pin Function	Remarks
DIM:113 to DIM:116	13, 18, 32, 43	VDD	Digital Power (VCC)
DIM:117 to DIM:120	14, 19, 31, 42	VSS	Digital Ground (VSS)

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INTERNAL AMPLIFIER

Operational amplifiers internal to the dsPIC33CK64MC105 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

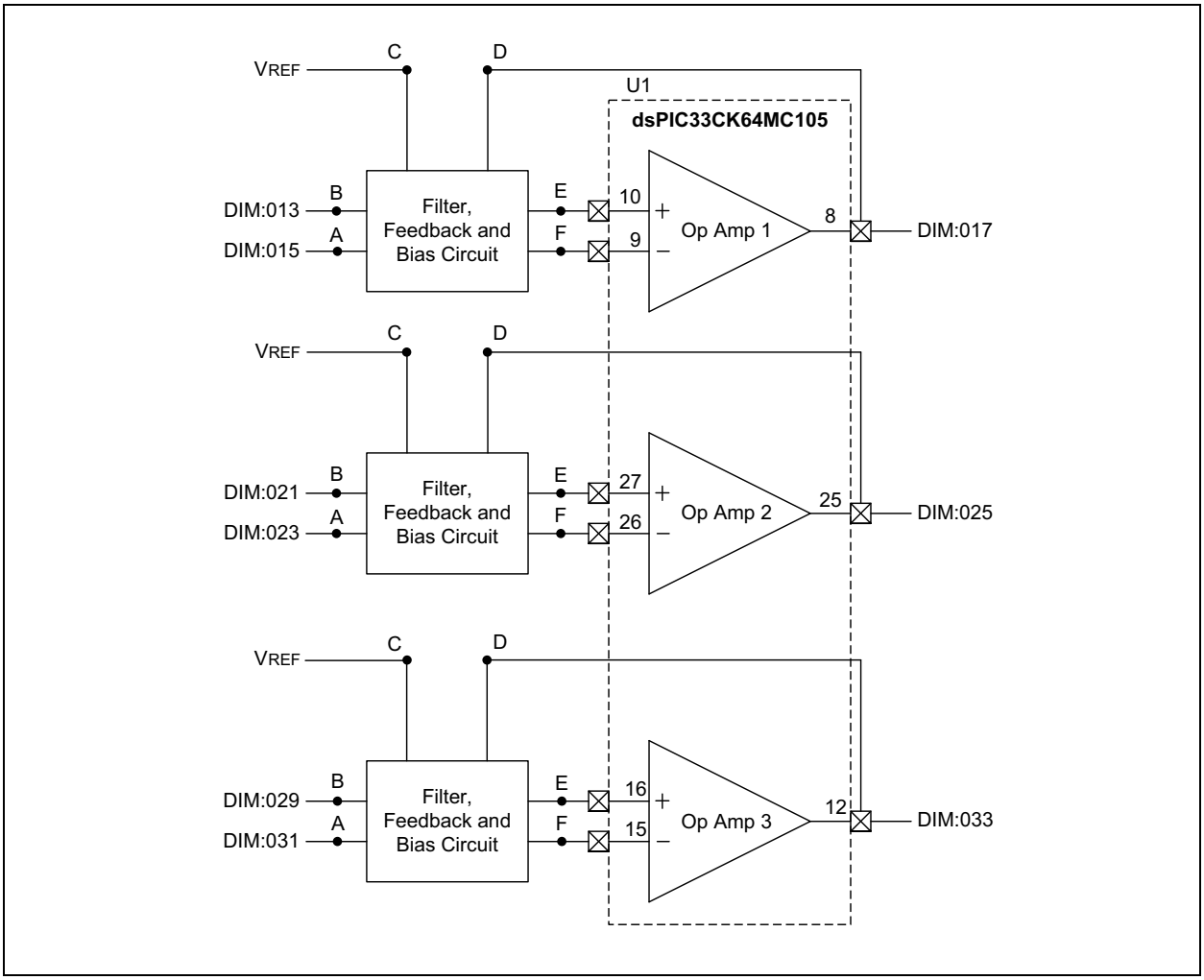
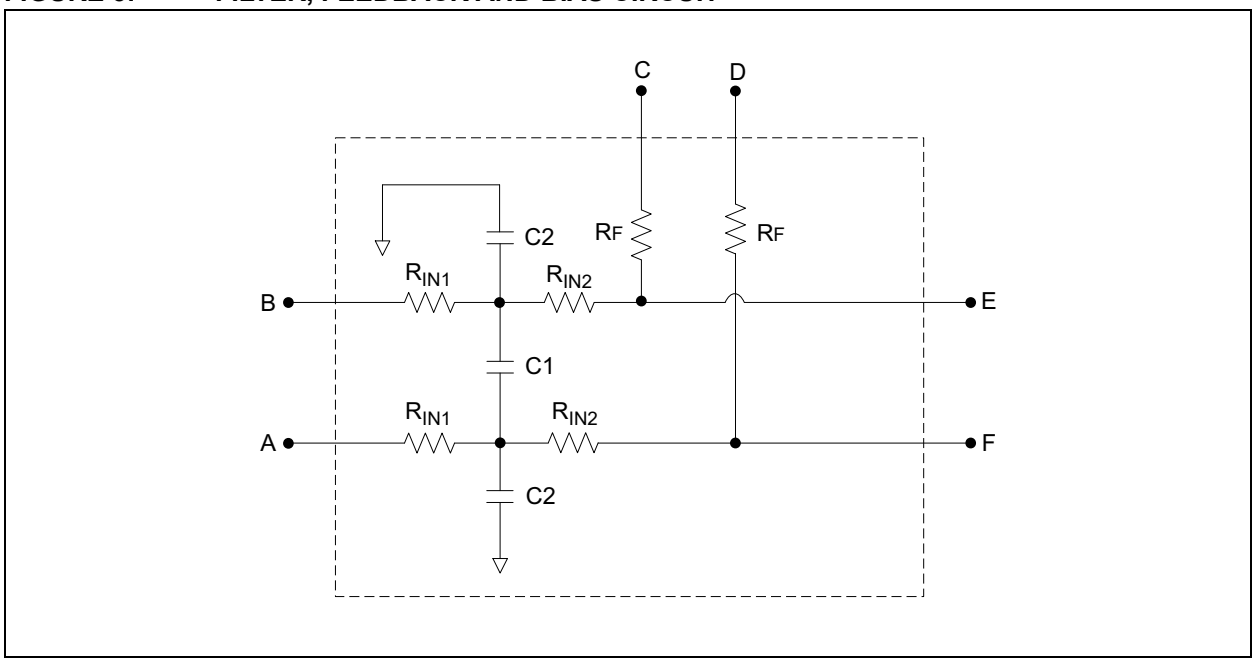


FIGURE 3: FILTER, FEEDBACK AND BIAS CIRCUIT



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

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

EQUATION 2: CUTOFF FREQUENCY DIFFERENTIAL-MODE FILTER

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

EQUATION 3: CUTOFF FREQUENCY COMMON-MODE FILTER

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

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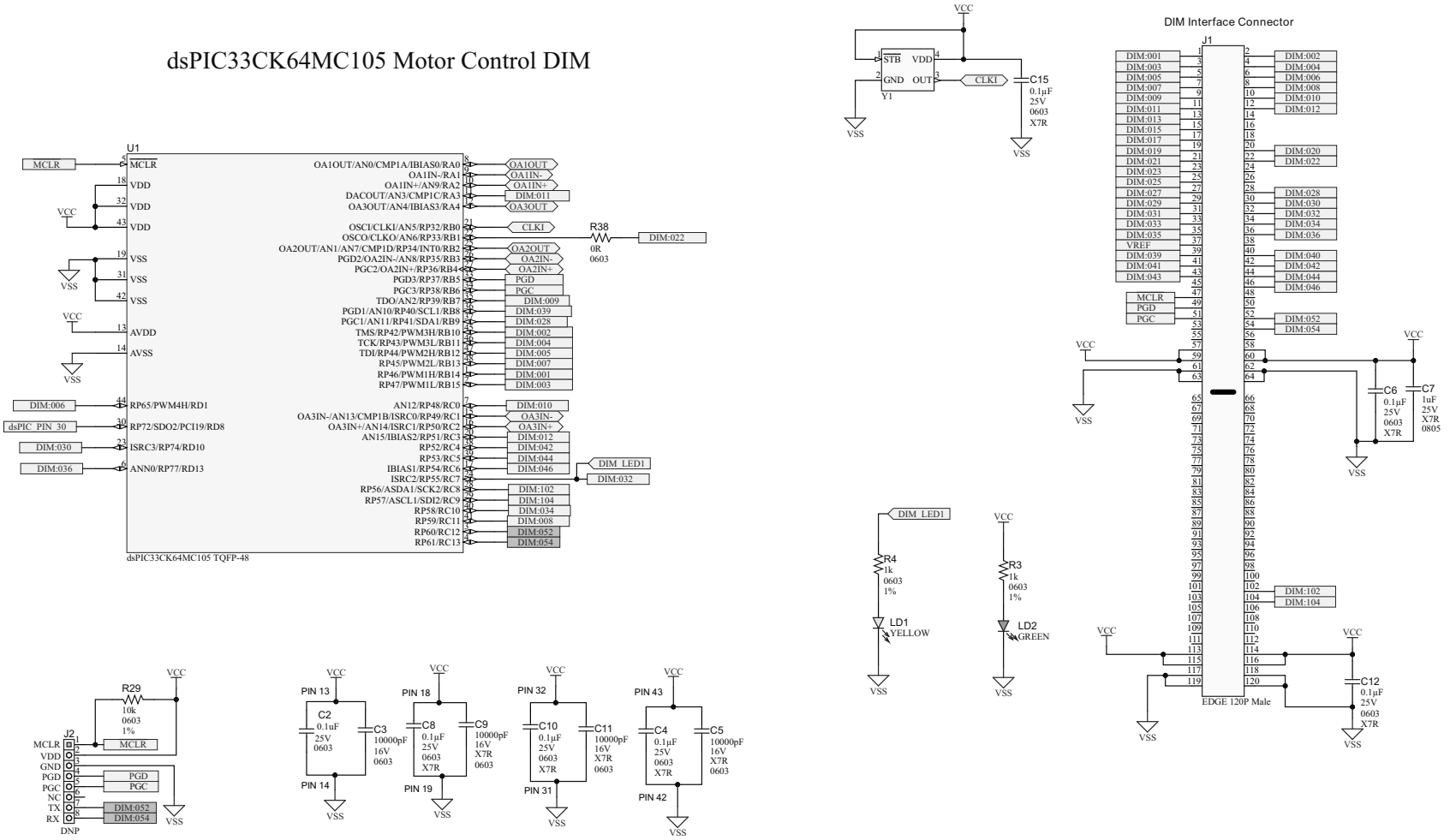
Table 4 summarizes the amplifier gain and filter cutoff frequencies for the amplifier circuit used in the DIM. The customer can select different values based on the application requirements, ensuring peak current is within the operating range of the Motor Control Board in which the DIM is inserted.

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	—

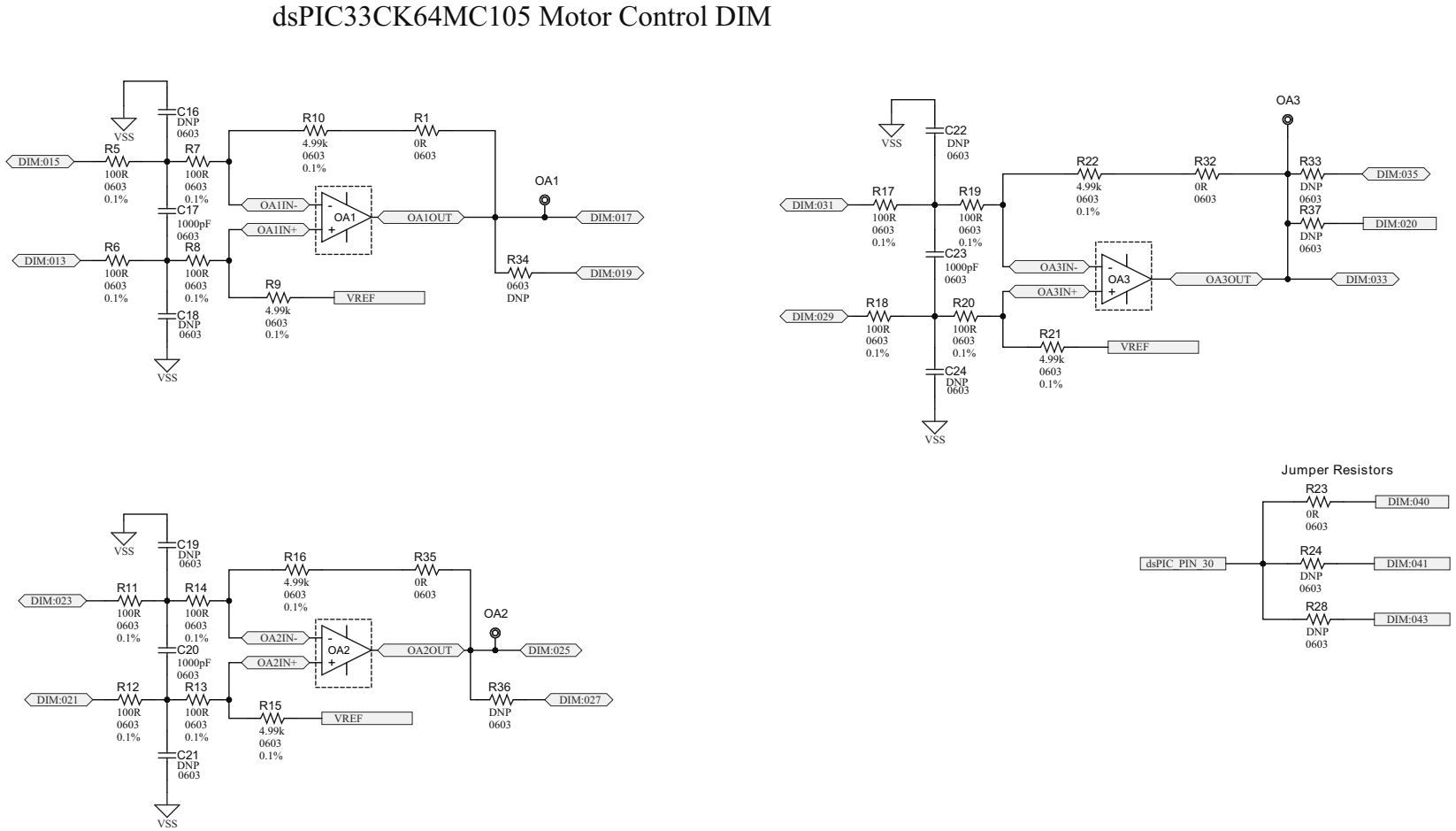
dsPIC33CK64MC105 Motor Control Dual In-Line Module (DIM)

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