dsPIC33AK512MC510 Motor Control Dual In-Line Module (DIM) Information Sheet

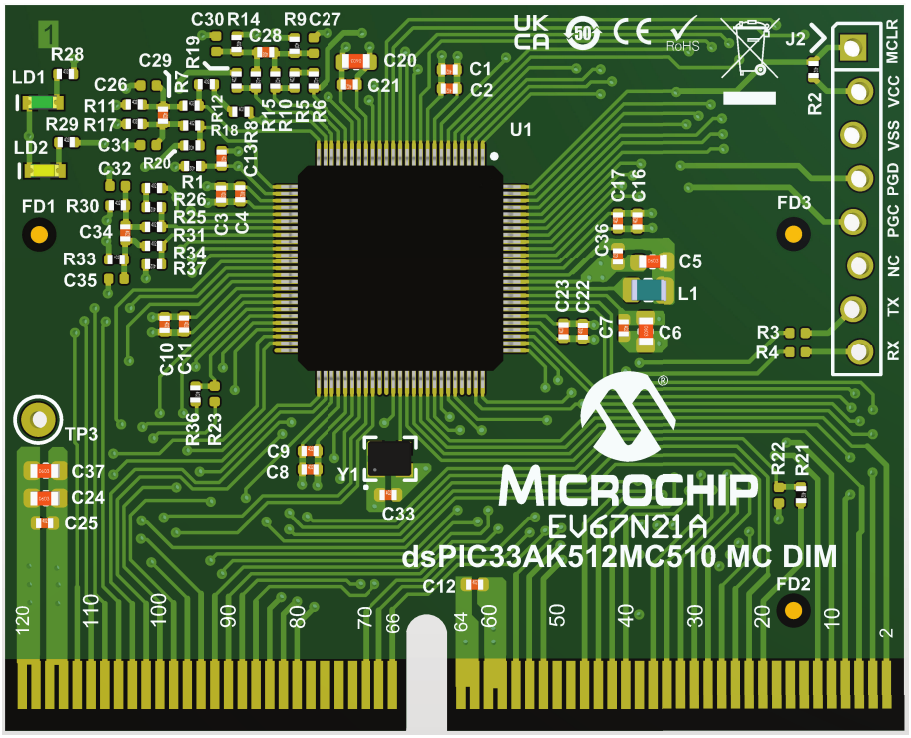
Introduction

The dsPIC33AK512MC510 Motor Control DIM (P/N: EV67N21A) is designed to demonstrate the motor control capabilities of the dsPIC33AK512MC510 device. This dsPIC® DSC features a 200 MHz, single-core Digital Signal Controller (DSC) with a 64-bit floating-point unit (FPU) and enhanced on-chip peripherals.

This motor control DIM is designed to take advantage of the high-speed motor control PWM generators, A/D converters, operational amplifiers, comparators and DACs.

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. The DIM is designed to run a single motor with all the compatible development boards. Table 1 provides information on the hardware versions of the motor control boards that are compatible with this DIM. For additional information regarding development boards, refer to the respective user's guide available on the Microchip website (www.microchip.com).

Figure 1. dsPIC33AK512MC510 Motor Control DIM (P/N: EV67N21A)



The 8-pin header J2 is provided for interfacing with the programmer/debugger. Any 8-pin, single-row, 0.100" (2.54 mm) pitch, unshrouded male header can be used (for example, P/N: 61300811121 from Würth Elektronik).

The LED LD1 (green) indicates the power-on status of the DIM. A general purpose LED LD2 (yellow) is provided on the board for debug purposes. The clock for the dsPIC DSC is generated by the MEMS Oscillator (Y1 – DSC6011JI2B-008.0000) provided on the DIM.

Table 1. Hardware Compatibility

Compatible Development Board	Part Number	Compatible Hardware Revision
MCLV-48V-300W	EV18H47A	All revisions
MCHV-230VAC-1.5kW	EV78U65A	All revisions

Note: The DIM is not compatible with earlier motor control development boards (for example, 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.

1. Pin Mapping

The following table provides pin mapping from the 100-pin dsPIC33AK512MC510 device to the DIM interface connector.

Table 1-1. Pin Mapping – dsPIC33AK512MC510 to DIM Interface Connector (Sorted By Device Pin Number)

Device Pin No.	Device Pin Function	DIM Pin No.	Remarks
1	CVDTX19/RP65/RE0	DIM:040	Direct connection
2	CVDTX20/RP66/RE1	DIM:036	Direct connection
3	CVDAN12/RP13/RA12	DIM:034	Direct connection
4	PGD2/AD3AN5/CVDAN0/RP1/SCL2/IOMAF2/RA0	DIM:049 (PGD)	Direct connection; also directly connected to Pin 4 of Header J2
5	AD5ANN1/AD5AN0/CVDAN7/RP8/SDA2/ IOMAF1/RA7	DIM:012	Direct connection
6	CVDTX22/RP68/RE3	DIM:032	Direct connection
7	PGC2/DACOUT1/AD5AN1/CVDAN1/ CMP4D/RP2/RA1	DIM:051 (PGC)	Direct connection; also directly connected to Pin 5 of Header J2
8	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
9	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
10	CVDTX21/RP67/RE2	DIM:030	Direct connection
11	CVDAN13/RP14/RA13	DIM:112	Direct connection
12	AD5ANN2/AD5AN2/CVDAN11/CMPFN/RP12/ RA11	DIM:010	Direct connection
13	DACOUT2/AD5AN3/CVDAN8/IBIAS3/ ISRC3/RP9/RA8	DIM:094	Connected via 0R (R32) resistor
		DIM:071	Can be connected via 0R (R27) resistor
		DIM:105	Can be connected via 0R (R24) resistor
14	UREF/AD1AN3/CVDAN9/IBIAS2/ISRC2/RP10/RA9	DIM:009	Direct connection
15	AD1ANN1/AD1AN4/CVDAN10/CMPEN/RP11/ RA10	DIM:011	Direct connection
16	CVDTX23/RP69/RE4	DIM:110	Direct connection
17	CVDAN15/RP16/RA15	DIM:108	Direct connection
18	AVSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
19	AVDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
20	CVDAN14/CMP1D/RP15/RA14	DIM:106	Direct connection

Table 1-1. Pin Mapping – dsPIC33AK512MC510 to DIM Interface Connector (Sorted By Device Pin Number) (continued)

Device Pin No.	Device Pin Function	DIM Pin No.	Remarks
21	OA1OUT/AD1AN0/CVDAN2/CMP1A/RP3/RA2	DIM:017	The output of Op Amp1 (OA1) when configured and enabled. • Ensure resistor R16 is removed and R6 is populated.
		DIM:019	Can be connected via 0R (R16) resistor. When connecting the signal: • Disable amplifier Op Amp1 (OA1) • Remove resistor R6
22	OA1IN-/AD1ANN2/AD1AN2/CVDAN3/CMPCN/CMP1C/RP4/RA3	DIM:015	Op Amp1 negative input; connected via amplifier input resistors
23	OA1IN+/AD1AN1/AD5AN4/CVDAN4/CMP1B/RP5/RA4	DIM:013	Op Amp1 positive input; connected via amplifier input resistors
24	OA3OUT/AD3AN0/CVDAN5/CMP3A/RP6/INT0/RA5	DIM:033	The output of Op Amp3 (OA3) when configured and enabled. • Ensure resistor R13 is removed and R8 is populated.
		DIM:035	Can be connected via 0R (R13) resistor. When connecting the signal: • Disable amplifier Op Amp3 (OA3) • Remove resistor R8
25	OA3IN-/AD3ANN2/AD3AN2/CVDAN6/CMPDN/CMP3C/RP7/RA6	DIM:031	Op Amp3 negative input; connected via amplifier input resistors
26	OA3IN+/AD3AN1/AD4AN5/CVDAN21/CVDTX5/CMP3B/RP22/RB5	DIM:029	Op Amp3 positive input; connected via amplifier input resistors
27	CVDAN28/CVDTX12/CMP3D/RP29/RB12	DIM:035	Connected via RC (R1, C13) filter
28	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
29	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
30	AD3ANN1/AD3AN3/CVDAN29/CVDTX13/RP30/RB13	DIM:020	Connected via 0R (R21) resistor
		DIM:026	Can be connected via 0R (R22) resistor

Table 1-1. Pin Mapping – dsPIC33AK512MC510 to DIM Interface Connector (Sorted By Device Pin Number) (continued)

Device Pin No.	Device Pin Function	DIM Pin No.	Remarks
31	OA2OUT/AD2AN0/CVDAN16/CVDTX0/CMP2A/ RP17/RB0	DIM:025	The output of Op Amp2 (OA2) when configured and enabled. • Ensure resistor R35 is removed and R26 is populated.
		DIM:027	Can be connected via 0R (R35) resistor. When connecting the signal: • Disable amplifier Op Amp2 (OA2) • Remove resistor R26
32	TMS/OA2IN-/AD2ANN2/AD2AN2/CVDAN17/ CVDTX1/CMP2C/RP18/RB1	DIM:023	Op Amp2 negative input; connected via amplifier input resistors
33	OA2IN+/AD2AN1/CVDAN18/CVDTX2/CMP2B/ RP19/RB2	DIM:021	Op Amp2 positive input; connected via amplifier input resistors
34	AD2AN4/CVDAN24/CVDTX8/CMP2D/RP25/RB8	DIM:022	Direct connection
35	AD2ANN1/AD2AN3/CVDAN25/CVDTX9/RP26/RB9	DIM:024	Direct connection
36	AD2AN5/CVDAN31/CVDTX15/RP32/RB15	DIM:028	Direct connection
37	AD3AN4/CVDTX29/RP81/RF0	DIM:039	Direct connection
38	CVDTX30/RP82/RF1	—	This pin is connected to a general-purpose LED (LD2 - Yellow) on the DIM.
39	CVDTX31/RP83/RF2	DIM:111	Direct connection
40	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
41	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
42	CVDAN30/CVDTX14/RP31/RB14	DIM:093	Direct connection
43	PGD1/AD4AN3/CVDAN19/CVDTX3/CMP4A/RP20/ SDA1/RB3	DIM:098	Direct connection
44	PGC1/AD4AN0/CVDAN20/CVDTX4/CMP4B/RP21/ SCL1/RB4	DIM:100	Connected via 0R (R42) resistor
		DIM:083	Can be connected via 0R (R43) resistor
45	AD4ANN2/AD4AN1/CVDAN22/CVDTX6/CMP/ IBIAS0/ISRC0/RP23/RB6	DIM:096	Connected via 0R (R36) resistor
		DIM:095	Can be connected via 0R (R23) resistor
46	AD4ANN1/AD4AN2/CVDAN23/CVDTX7/CMP4C/ IBIAS1/ISRC1/RP24/IOMAF0/RB7	DIM:084	Direct connection
47	AD4AN4/CVDAN26/CVDTX10/RP27/SCK2/ IOMAF11/IOMBF11/RB10	DIM:082	Direct connection
48	CVDAN27/CVDTX11/RP28/IOMAF10/IOMBF10/ SDI2/RB11	DIM:103	Direct connection
49	RP84/RF3	DIM:087	Direct connection
50	NC	—	No connection
51	RP97/RG0	DIM:101	Direct connection
52	RP98/APWM4H/IOMBD11/RG1	DIM:085	Direct connection
53	RP99/APWM4L/IOMBD10/RG2	DIM:080	Direct connection

Table 1-1. Pin Mapping – dsPIC33AK512MC510 to DIM Interface Connector (Sorted By Device Pin Number) (continued)

Device Pin No.	Device Pin Function	DIM Pin No.	Remarks
54	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
55	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
56	RP41/APWM1L/IOMAD8/IOMBF3/RC8	DIM:067	Direct connection
57	RP42/SDO2/IOMBF2/RC9	DIM:065	Direct connection
58	RP39/SCL3/RC6	DIM:099	Direct connection
59	RP40/SDA3/IOMAF7/RC7	DIM:097	Direct connection
60	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
61	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
62	OSCO/CLKO/RP33/IOMAF5/RC0	—	Connected to Test Point TP2 on the DIM
63	OSCI/CLKI/RP34/IOMAF6/RC1	—	CLKI - clock output of the MEMS Oscillator (Y1) is connected as an input clock of dsPIC DSC (U1)
64	PGC3/RP35/PWM4H/IOMAD7/RC2	DIM:006	Direct connection
65	PGD3/RP38/PWM4L/IOMAD6/RC5	DIM:008	Direct connection
66	RP36/PWM3H/IOMAD5/RC3	DIM:002	Direct connection
67	RP37/PWM3L/IOMAD4/RC4	DIM:004	Direct connection
68	RP43/PWM7H/IOMBD5/IOMBF1/RC10	DIM:102	Direct connection
69	RP44/PWM7L/IOMBD4/IOMBF0/RC11	DIM:104	Direct connection
70	RP45/PWM8H/IOMBD7/RC12	DIM:088	Connected via 0R (R40) resistor
		DIM:091	Can be connected via 0R (R41) resistor
71	RP46/PWM8L/IOMBD6/RC13	DIM:092	Direct connection
72	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
73	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
74	RP47/APWM3H/IOMBD9/RC14	DIM:054	Direct connection; it can also be connected to Pin 8 of Header J2 through resistor R4.
75	RP48/APWM3L/IOMBD8/RC15	DIM:052	Direct connection; it can also be connected to Pin 7 of Header J2 through resistor R3.
76	RP58/PWM6H/IOMBD3/IOMBF7/RD9	DIM:086	Connected via 0R (R38) resistor
		DIM:089	Can be connected via 0R (R39) resistor
77	RP59/PWM6L/IOMBD2/IOMAF9/IOMBF9/RD10	DIM:090	Direct connection
78	RP49/PWM2H/IOMAD3/RD0	DIM:005	Direct connection
79	TCK/RP50/PWM2L/IOMAD2/RD1	DIM:007	Direct connection
80	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)

Table 1-1. Pin Mapping – dsPIC33AK512MC510 to DIM Interface Connector (Sorted By Device Pin Number) (continued)

Device Pin No.	Device Pin Function	DIM Pin No.	Remarks
81	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
82	TDO/RP51/PWM1H/IOMAD1/RD2	DIM:001	Direct connection
83	TDI/RP52/PWM1L/IOMAD0/RD3	DIM:003	Direct connection
84	SWVDD	—	Connected to Digital Power (VCC)
85	Lx	—	Connected to Inductor L1
86	SWVSS	—	Connected to Digital Ground (VSS)
87	VDDCORE	—	Connected to Inductor L1, Capacitors C5 and C36
88	VSS	DIM:061 to DIM:064, DIM:117 to DIM:120	Digital Ground (VSS)
89	VDD	DIM:057 to DIM:060, DIM:113 to DIM:116	Digital Power (VCC)
90	RP54/PWM5H/ASCL1/IOMBD1/RD5	DIM:068	Direct connection
91	RP55/PWM5L/ASDA1/IOMBD0/RD6	DIM:070	Direct connection
92	CVDTX16/RP53/ASCL3/IOMBF6/RD4	DIM:066	Direct connection
93	RP60/APWM1H/IOMAD9/IOMAF8/IOMBF8/RD11	DIM:056	Direct connection
94	RP61/ASDA3/RD12	DIM:046	Direct connection
95	RP62/IOMBF4/RD13	DIM:044	Direct connection
96	RP63/APWM2H/IOMAD11/RD14	DIM:042	Direct connection
97	RP64/APWM2L/IOMAD10/IOMBF5/RD15	DIM:045	Direct connection
98	CVDTX17/RP56/ASCL2/IOMAF4/RD7	DIM:043	Direct connection
99	CVDTX18/RP57/ASDA2/IOMAF3/RD8	DIM:041	Direct connection
100	$\overline{\text{MCLR}}$	DIM:047 ($\overline{\text{MCLR}}$)	Direct connection; also directly connected to Pin 1 of Header J2

The following table provides pin mapping from the DIM interface connector to the 100-pin dsPIC33AK512MC510 device.

Table 1-2. Pin Mapping – DIM Interface Connector to dsPIC33AK512MC510 (Sorted by DIM Pin Number)

DIM Pin No.	Device Pin No.	Device Pin Function	Remarks
DIM:001	82	TDO/RP51/PWM1H/IOMAD1/RD2	Direct connection
DIM:002	66	RP36/PWM3H/IOMAD5/RC3	Direct connection
DIM:003	83	TDI/RP52/PWM1L/IOMAD0/RD3	Direct connection
DIM:004	67	RP37/PWM3L/IOMAD4/RC4	Direct connection
DIM:005	78	RP49/PWM2H/IOMAD3/RD0	Direct connection
DIM:006	64	PGC3/RP35/PWM4H/IOMAD7/RC2	Direct connection
DIM:007	79	TCK/RP50/PWM2L/IOMAD2/RD1	Direct connection
DIM:008	65	PGD3/RP38/PWM4L/IOMAD6/RC5	Direct connection
DIM:009	14	UREF/AD1AN3/CVDAN9/IBIAS2/ISRC2/RP10/RA9	Direct connection
DIM:010	12	AD5ANN2/AD5AN2/CVDAN11/CMPFN/RP12/RA11	Direct connection
DIM:011	15	AD1ANN1/AD1AN4/CVDAN10/CMPEN/RP11/RA10	Direct connection
DIM:012	5	AD5ANN1/AD5AN0/CVDAN7/RP8/SDA2/IOMAF1/RA7	Direct connection
DIM:013	23	OA1IN+/AD1AN1/AD5AN4/CVDAN4/CMP1B/RP5/RA4	Op Amp1 positive input; connected via amplifier input resistors
DIM:014	—	—	No connection
DIM:015	22	OA1IN-/AD1ANN2/AD1AN2/CVDAN3/CMPCN/ CMP1C/RP4/RA3	Op Amp1 negative input; connected via amplifier input resistors
DIM:016	—	—	No connection
DIM:017	21	OA1OUT/AD1AN0/CVDAN2/CMP1A/RP3/RA2	The output of Op Amp1 (OA1) when configured and enabled. • Ensure resistor R16 is removed and R6 is populated.
DIM:018	—	—	No connection
DIM:019	21	OA1OUT/AD1AN0/CVDAN2/CMP1A/RP3/RA2	Can be connected via 0R (R16) resistor. When connecting the signal: • Disable amplifier Op Amp1 (OA1) • Remove resistor R6
DIM:020	30	AD3ANN1/AD3AN3/CVDAN29/CVDTX13/RP30/RB13	Connected via 0R (R21) resistor
DIM:021	33	OA2IN+/AD2AN1/CVDAN18/CVDTX2/CMP2B/ RP19/RB2	Op Amp2 positive input; connected via amplifier input resistors
DIM:022	34	AD2AN4/CVDAN24/CVDTX8/CMP2D/RP25/RB8	Direct connection
DIM:023	32	TMS/OA2IN-/AD2ANN2/AD2AN2/CVDAN17/CVDTX1/ CMP2C/RP18/RB1	Op Amp2 negative input; connected via amplifier input resistors
DIM:024	35	AD2ANN1/AD2AN3/CVDAN25/CVDTX9/RP26/RB9	Direct connection
DIM:025	31	OA2OUT/AD2AN0/CVDAN16/CVDTX0/CMP2A/ RP17/RB0	The output of Op Amp2 (OA2) when configured and enabled. • Ensure resistor R35 is removed and R26 is populated.
DIM:026	30	AD3ANN1/AD3AN3/CVDAN29/CVDTX13/RP30/RB13	Can be connected via 0R (R22) resistor
DIM:027	31	OA2OUT/AD2AN0/CVDAN16/CVDTX0/CMP2A/ RP17/RB0	Can be connected via 0R (R35) resistor. When connecting the signal: • Disable amplifier Op Amp2 (OA2) • Remove resistor R26
DIM:028	36	AD2AN5/CVDAN31/CVDTX15/RP32/RB15	Direct connection

Table 1-2. Pin Mapping – DIM Interface Connector to dsPIC33AK512MC510 (Sorted by DIM Pin Number) (continued)

DIM Pin No.	Device Pin No.	Device Pin Function	Remarks
DIM:029	26	OA3IN+/AD3AN1/AD4AN5/CVDAN21/CVDTX5/ CMP3B/RP22/RB5	Op Amp3 positive input; connected via amplifier input resistors
DIM:030	10	CVDTX21/RP67/RE2	Direct connection
DIM:031	25	OA3IN-/AD3ANN2/AD3AN2/CVDAN6/CMPDN/ CMP3C/RP7/RA6	Op Amp3 negative input; connected via amplifier input resistors
DIM:032	6	CVDTX22/RP68/RE3	Direct connection
DIM:033	24	OA3OUT/AD3AN0/CVDAN5/CMP3A/RP6/INT0/RA5	The output of Op Amp3 (OA3) when configured and enabled. • Ensure resistor R13 is removed and R8 is populated.
DIM:034	3	CVDAN12/RP13/RA12	Direct connection
DIM:035	24	OA3OUT/AD3AN0/CVDAN5/CMP3A/RP6/INT0/RA5	Can be connected via 0R (R13) resistor. When connecting the signal: • Disable amplifier Op Amp3 (OA3) • Remove resistor R8
	27	CVDAN28/CVDTX12/CMP3D/RP29/RB12	Connected via RC (R1, C13) filter
DIM:036	2	CVDTX20/RP66/RE1	Direct connection
DIM:037 (VREF)	23,26,33	Connected to positive input of amplifiers OA1, OA2 and OA3 through gain resistor	VREF (+1.65V) input from the motor control development board
DIM:038	—	—	No connection
DIM:039	37	AD3AN4/CVDTX29/RP81/RF0	Direct connection
DIM:040	1	CVDTX19/RP65/RE0	Direct connection
DIM:041	99	CVDTX18/RP57/ASDA2/IOMAF3/RD8	Direct connection
DIM:042	96	RP63/APWM2H/IOMAD11/RD14	Direct connection
DIM:043	98	CVDTX17/RP56/ASCL2/IOMAF4/RD7	Direct connection
DIM:044	95	RP62/IOMBF4/RD13	Direct connection
DIM:045	97	RP64/APWM2L/IOMAD10/IOMBF5/RD15	Direct connection
DIM:046	94	RP61/ASDA3/RD12	Direct connection
DIM:047 (MCLR)	100	$\overline{\text{MCLR}}$	Direct connection; also directly connected to Pin 1 of Header J2
DIM:048	—	—	No connection
DIM:049 (PGD)	4	PGD2/AD3AN5/CVDAN0/RP1/SCL2/IOMAF2/RA0	Direct connection; also directly connected to Pin 4 of Header J2
DIM:050	—	—	No connection
DIM:051 (PGC)	7	PGC2/DACOUT1/AD5AN1/CVDAN1/CMP4D/RP2/RA1	Direct connection; also directly connected to Pin 5 of Header J2
DIM:052	75	RP48/APWM3L/IOMBD8/RC15	Direct connection; it can also be connected to Pin 7 of Header J2 through resistor R3.
DIM:053	—	—	No connection
DIM:054	74	RP47/APWM3H/IOMBD9/RC14	Direct connection; it can also be connected to Pin 8 of Header J2 through resistor R4.
DIM:055	—	—	No connection
DIM:056	93	RP60/APWM1H/IOMAD9/IOMAF8/IOMBF8/RD11	Direct connection

Table 1-2. Pin Mapping – DIM Interface Connector to dsPIC33AK512MC510 (Sorted by DIM Pin Number) (continued)

DIM Pin No.	Device Pin No.	Device Pin Function	Remarks
DIM:057 to DIM:060	9,19,29,41,55, 61,73,81,89	VDD	Digital Power (VCC)
DIM:061 to DIM:064	8,18,28,40,54, 60,72,80,88	VSS	Digital Ground (VSS)
DIM:065	57	RP42/SDO2/IOMBF2/RC9	Direct connection
DIM:066	92	CVDTX16/RP53/ASCL3/IOMBF6/RD4	Direct connection
DIM:067	56	RP41/APWM1L/IOMAD8/IOMBF3/RC8	Direct connection
DIM:068	90	RP54/PWM5H/ASCL1/IOMBD1/RD5	Direct connection
DIM:069	—	—	No connection
DIM:070	91	RP55/PWM5L/ASDA1/IOMBD0/RD6	Direct connection
DIM:071	13	DACOUT2/AD5AN3/CVDAN8/IBIAS3/ISRC3/RP9/RA8	Can be connected via 0R (R27) resistor
DIM:072	—	—	No connection
DIM:073	—	—	No connection
DIM:074	—	—	No connection
DIM:075	—	—	No connection
DIM:076	—	—	No connection
DIM:077	—	—	No connection
DIM:078	—	—	No connection
DIM:079	—	—	No connection
DIM:080	53	RP99/APWM4L/IOMBD10/RG2	Direct connection
DIM:081	—	—	—
DIM:082	47	AD4AN4/CVDAN26/CVDTX10/RP27/SCK2/IOMAF11/ IOMBF11/RB10	Direct connection
DIM:083	44	PGC1/AD4AN0/CVDAN20/CVDTX4/CMP4B/RP21/ SCL1/RB4	Can be connected via 0R (R43) resistor
DIM:084	46	AD4ANN1/AD4AN2/CVDAN23/CVDTX7/CMP4C/ IBIAS1/ISRC1/RP24/IOMAF0/RB7	Direct connection
DIM:085	52	RP98/APWM4H/IOMBD11/RG1	Direct connection
DIM:086	76	RP58/PWM6H/IOMBD3/IOMBF7/RD9	Connected via 0R (R38) resistor
DIM:087	49	RP84/RF3	Direct connection
DIM:088	70	RP45/PWM8H/IOMBD7/RC12	Connected via 0R (R40) resistor
DIM:089	76	RP58/PWM6H/IOMBD3/IOMBF7/RD9	Can be connected via (R39) resistor
DIM:090	77	RP59/PWM6L/IOMBD2/IOMAF9/IOMBF9/RD10	Direct connection
DIM:091	70	RP45/PWM8H/IOMBD7/RC12	Can be connected via 0R (R41) resistor
DIM:092	71	RP46/PWM8L/IOMBD6/RC13	Direct connection
DIM:093	42	CVDAN30/CVDTX14/RP31/RB14	Direct connection
DIM:094	13	DACOUT2/AD5AN3/CVDAN8/IBIAS3/ ISRC3/RP9/RA8	Connected via 0R (R32) resistor
DIM:095	45	AD4ANN2/AD4AN1/CVDAN22/CVDTX6/ CMP/IBIAS0/ ISRC0/RP23/RB6	Can be connected via 0R (R23) resistor
DIM:096			Connected via 0R (R36) resistor
DIM:097	59	RP40/SDA3/IOMAF7/RC7	Direct connection
DIM:098	43	PGD1/AD4AN3/CVDAN19/CVDTX3/ CMP4A/RP20/ SDA1/RB3	Direct connection
DIM:099	58	RP39/SCL3/RC6	Direct connection

Table 1-2. Pin Mapping – DIM Interface Connector to dsPIC33AK512MC510 (Sorted by DIM Pin Number) (continued)

DIM Pin No.	Device Pin No.	Device Pin Function	Remarks
DIM:100	44	PGC1/AD4AN0/CVDAN20/CVDTX4/ CMP4B/RP21/ SCL1/RB4	Connected via 0R (R42) resistor
DIM:101	51	RP97/RG0	Direct connection
DIM:102	68	RP43/PWM7H/IOMBD5/IOMBF1/RC10	Direct connection
DIM:103	48	CVDAN27/CVDTX11/RP28/IOMAF10/ IOMBF10/SDI2/ RB11	Direct connection
DIM:104	69	RP44/PWM7L/IOMBD4/IOMBF0/RC11	Direct connection
DIM:105	13	DACOUT2/AD5AN3/CVDAN8/IBIAS3/ISRC3/RP9/RA8	Can be connected via 0R (R24) resistor
DIM:106	20	CVDAN14/CMP1D/RP15/RA14	Direct connection
DIM:107	—	—	No connection
DIM:108	17	CVDAN15/RP16/RA15	Direct connection
DIM:109	—	—	No connection
DIM:110	16	CVDTX23/RP69/RE4	Direct connection
DIM:111	39	CVDTX31/RP83/RF2	Direct connection
DIM:112	11	CVDAN13/RP14/RA13	Direct connection
DIM:113 to DIM:116	9,19,29,41,55, 61,73,81,89	VDD	Digital Power (VCC)
DIM:117 to DIM:120	8,18,28,40,54, 60,72,80,88	VSS	Digital Ground (VSS)

2. Internal Amplifier

Operational amplifiers internal to the dsPIC33AK512MC510 can be configured and enabled for amplifying motor currents (internal Op Amp configuration). The amplifier circuits are shown in the Figure 2-1 and Figure 4-2. The detailed schematics of the block, “Filter, Feedback and Bias Circuit” used in Figure 2-1, are shown in Figure 2-2.

Figure 2-1. dsPIC® DSC Internal Amplifiers

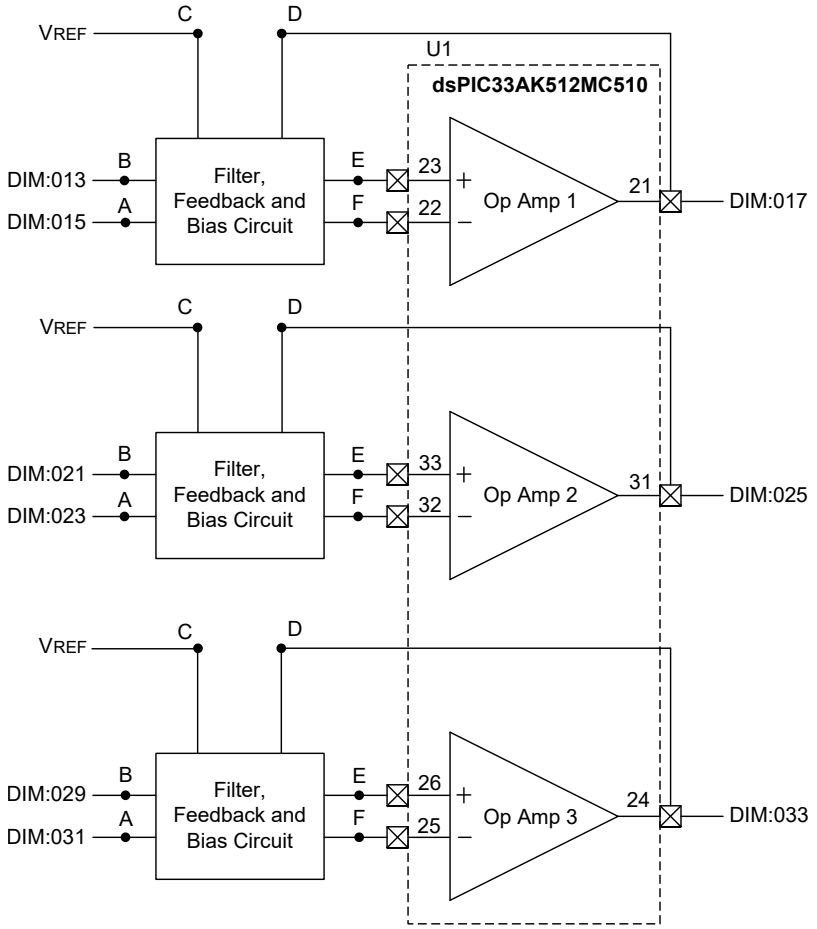
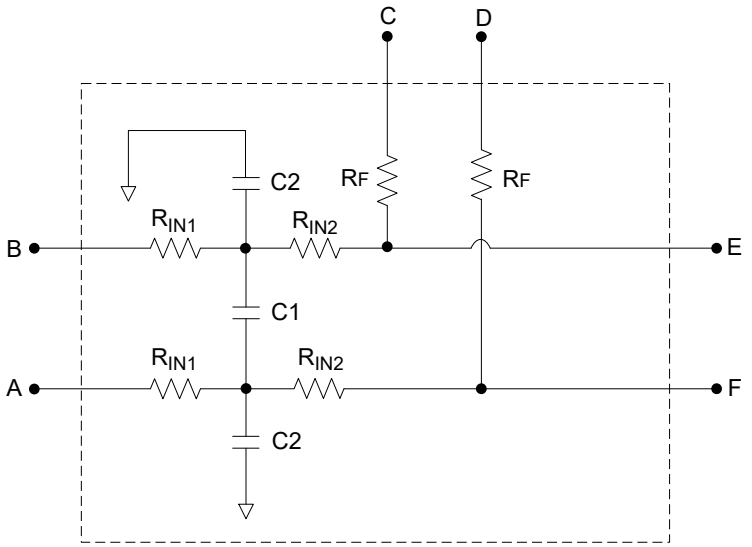


Figure 2-2. Filter, Feedback and Bias Circuit



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

Equation 2-1. Amplifier Gain

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

Equation 2-2. 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 2-3. Cutoff Frequency Common-Mode Filter

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

The following table 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 development board in which the DIM is inserted.

Table 2-1. 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			
100 Ω	100 Ω	4.99 kΩ	1000 pF	Not Populated	24.95	796 kHz	—

3. External Amplifier

Some motor control development boards (see Table 1) are equipped with Operational Amplifiers to amplify the motor phase currents and DC bus current (external Op Amp configuration). Refer to the User's Guide of the specific development board to obtain information on amplifier gain.

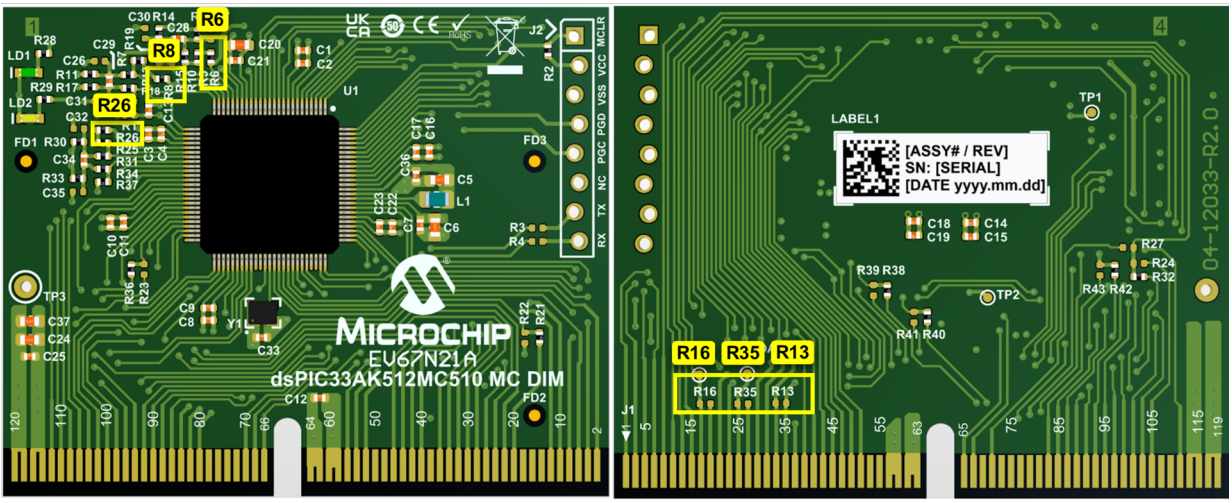
The external amplifier outputs from the development board and the internal amplifier outputs of the dsPIC® DSC are connected to a single analog channel on the DIM.

The DIM is configured to use the internal amplifier outputs of the dsPIC® DSC by default. The following table summarizes the jumper resistors to be populated and removed to convert the DIM from 'internal Op Amp configuration' to 'external Op Amp configuration' or vice versa.

Table 3-1. Selection Between Internal and External Amplifier Configuration

Operational Amplifier	Jumper Resistor (0R) Settings on the DIM				Firmware Setting
	Internal Amplifier Configuration (default)		External Amplifier Configuration		
	Populate	Remove	Populate	Remove	
OA1	R6	R16	R16	R6	• Configure and enable internal amplifiers in 'internal Op Amp configuration' • Ensure the internal amplifiers are disabled in the 'external Op Amp configuration'
OA2	R26	R35	R35	R26	
OA3	R8	R13	R13	R8	

Figure 3-1. Jumper Resistors (or) on the DIM for Amplifier Output Selection



4. Board Schematics: Motor Control Dual In-Line Module (MC DIM)

Figure 4-1. Schematic Revision 2.0, Page 1 of 2

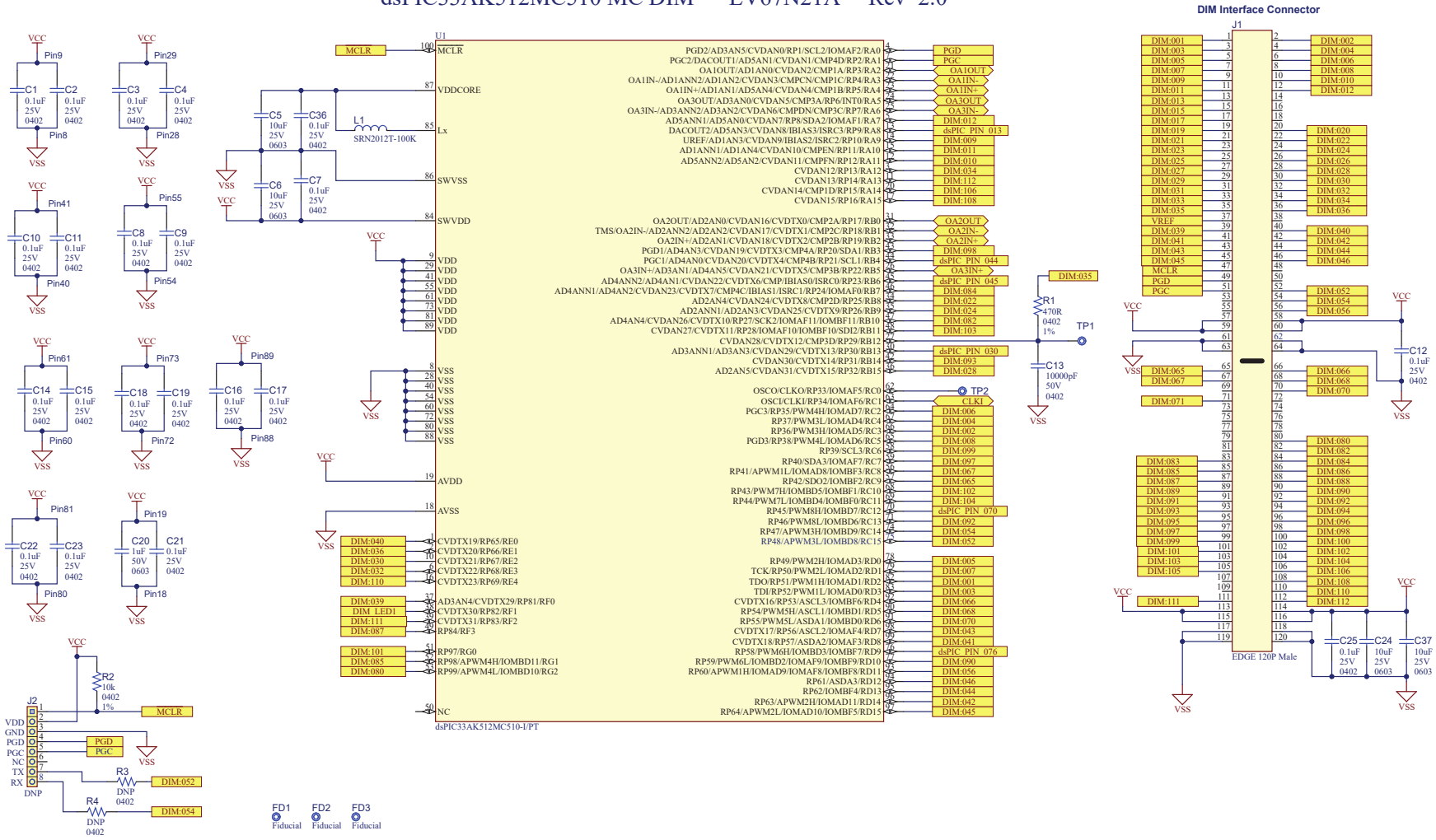
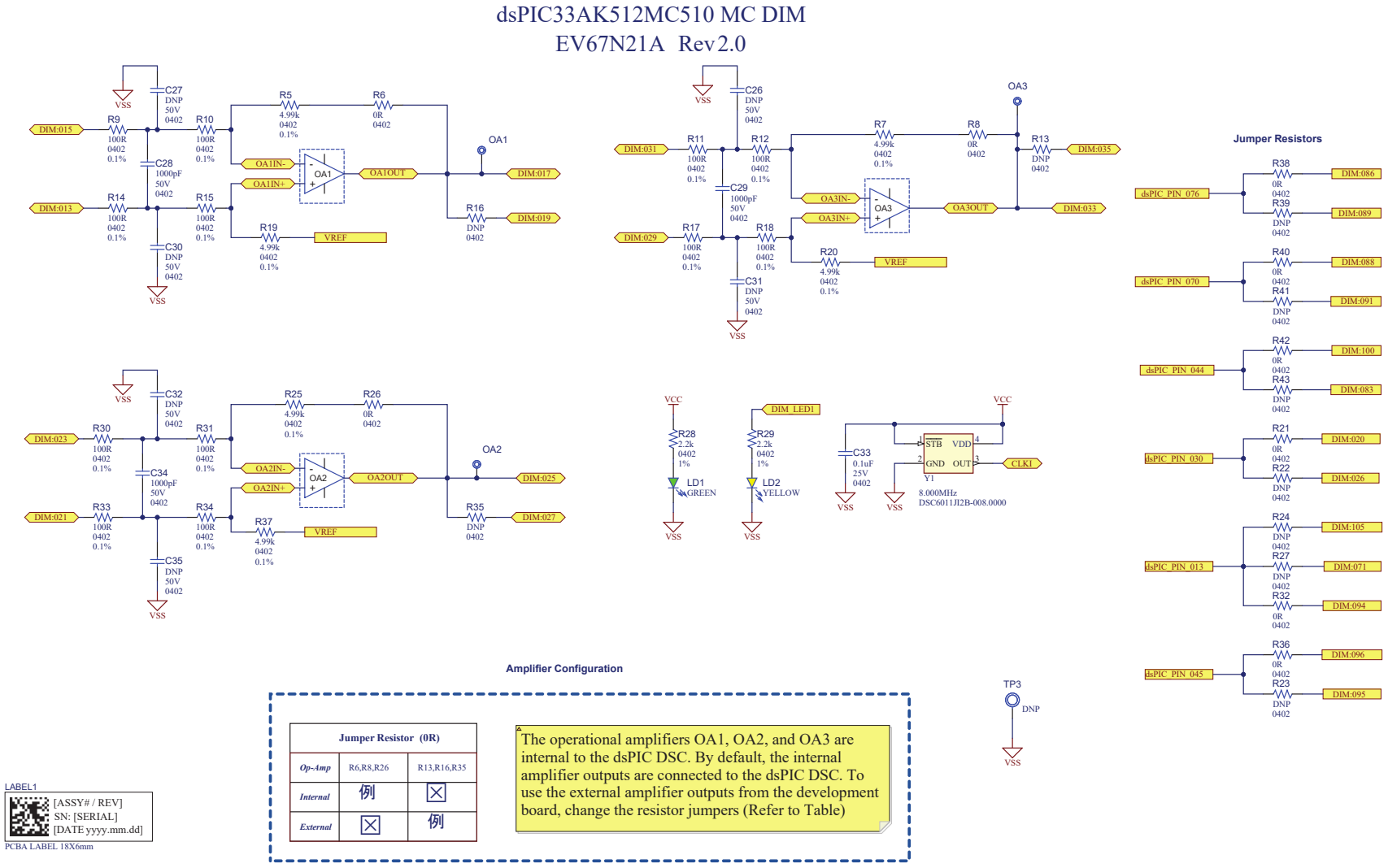


Figure 4-2. Schematic Revision 2.0, Page 2 of 2



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