ATSAMC21 Motor Control Dual In-Line Module (DIM) Information Sheet

ATSAMC21J18A

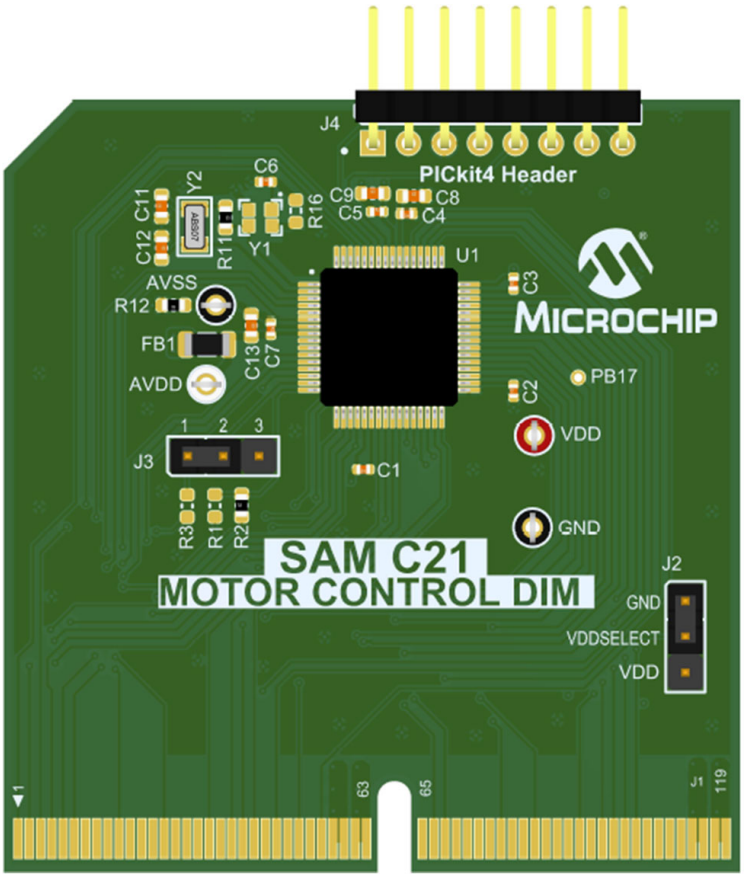
Introduction

The ATSAMC21 Motor Control DIM (EV74G56A) is designed to demonstrate the motor control capabilities of the ATSAMC21J18A device. The SAM C series combines the performance and energy efficiency of an Arm® Cortex®-M0+ based microcontroller (MCU) with an optimized architecture and peripheral set. These flexible and easy-to-use 5V MCUs are ideal for home appliances, industrial control, and other 5V applications.

This motor control DIM is designed to take advantage of a PWM Module (TCC), a dual ADC, Event System, and Interrupt Units 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. The following table 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. ATSAMC21 Motor Control DIM (EV74G56A)



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The 8-pin header J4 is provided for interfacing the programmer or debugger.

Table 1. Hardware Compatibility

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

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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1. DIM Interface Connection Details

The following table provides the pin mapping from the 64-pin ATSAMC21J18A device to the DIM interface connector.

Table 1-1. Pin Mapping - ATSAMC21J18A to DIM Interface Connector (Sorted by Device Pin Number)

Device Pin#	DIM Pin#	SAM C21 Pad Name	Signal Name	Remarks
1	-	XIN32	Crystal Clock Input	Connected to 32.768 kHz External Crystal
2	-	XOUT32	Crystal Clock Output	Connected to 32.768 kHz External Crystal
3	DIM:9	PA02	MOTOR1 Phase A BEMF Voltage	Direct Connection
4	DIM:11	PA03	MOTOR1 Phase B BEMF Voltage	Direct Connection
5	DIM:68	PB04	Hall B Input Signal	Direct Connection
6	DIM:22	PB05	MOTOR1 Phase C BEMF Voltage	Direct Connection
7	DIM:61 to DIM:64, DIM:117 to DIM:120	GNDANA	Analog Ground	GNDANA is connected to GND via 0R (R12) resistor.
8	DIM:57 to DIM:60, DIM:113 to DIM:116	AVDD	Analog Supply	AVDD is connected to VDD via Filter. Refer to the *Schematics* for the circuitry.
9	DIM: 88	PB06	XPRO1 GPIO2	Direct Connection
10	MCU pin shared by signals from DIM: 10 & DIM: 69	PB07	PFC VAC (DIM: 10) or BEMF Neutral Signal (DIM: 69)	Redundant selection with 0R (R3 and R4) resistors and J3 (Please note, will be corrected in the next revision with either selection with resistors or jumper). Populate both (0R) R3 and (0R) R4 resistors. For PFC VAC: Short J3 1 and 2, For BEMF Neutral: Short J3 2 and 3. **Note:** J3 output goes to PB07 and PA06 and they are connected together.
11	DIM: 19	PB08	Motor 1 Phase A current from external OPAMP	Direct Connection
12	DIM: 27	PB09	Motor 1 Phase B current from external OPAMP	Direct Connection
13	DIM: 12	PA04	PFC DC Link Current	Direct Connection
14	DIM: 5	PA05	Motor 1 Phase B High Side PWM	Direct Connection
15	MCU pin shared by signals from DIM: 10 & DIM: 69	PA06	PFC VAC (DIM: 10) or BEMF Neutral Signal (DIM: 69)	Redundant selection with (0R) R3 and (0R) R4 resistors and J3 (Please note, will be corrected in the next revision with either selection with resistors or jumper). Populate both (0R) R3 and (0R) R4 resistors. For PFC VAC: Short J3 1 and 2, For BEMF Neutral: Short J3 2 and 3. **Note:** J3 output goes to PB07 and PA06 and they are connected together.
16	MCU pin shared by signals from DIM: 20 & DIM: 24	PA07	Motor1 Phase Current C (DIM:20) or IPM Temperature (DIM:24)	By default (0R) R2 is populated for IPM temperature signal. For Motor 1 Phase C Current: Populate (0R) R1 and do not Populate (0R) R2. For IPM Temp: Populate (0R) R2 and do not Populate (0R) R1.
17	DIM: 35	PA08	MOTOR1 DC Link Current IBUS	Direct Connection

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Device Pin#	DIM Pin#	SAM C21 Pad Name	Signal Name	Remarks
18	DIM: 39	PA09	Motor 1 DC Voltage VBUS Input	Direct Connection
19	DIM: 2	PA10	Motor 1 Phase C High Side PWM	Direct Connection
20	MCU pin shared by signals from DIM: 26 & DIM: 82	PA11	External Temperature 1 Signal (DIM: 26) or XPRO1 ADC (+) (DIM: 82)	By default (0R) R6 is populated for XPRO1 ADC(+) signal; For External Temperature 1: Populate (0R) R5 and do not Populate (0R) R6. For XPRO1 ADC(+): Populate (0R) R6 and do not Populate (0R) R5.
21	DIM:57 to DIM:60, DIM:113 to DIM:116	VDDIO	VDD	VDD; Digital Power
22	DIM:61 to DIM:64, DIM:117 to DIM:120	GND	GND	Digital Power Ground
23	DIM: 8	PB10	PFC ENABLE	Direct Connection
24	DIM: 66	PB11	Hall A Input Signal	Direct Connection
25	DIM: 30	PB12	LED1 Signal	Direct Connection
26	DIM: 32	PB13	LED2 Signal	Direct Connection
27	DIM: 103	PB14	CAN Transmit Signal	Direct Connection
28	DIM: 101	PB15	CAN Receive Signal	Direct Connection
29	MCU pin shared by signals from DIM: 6 & DIM: 98	PA12	PFC PWM (DIM: 6) or XPRO1 I2C SDA (DIM: 98)	By default (0R) R8 is populated for PFC PWM Signal. For PFC PWM: Populate (0R) R8 and do not Populate (0R) R7. For XPRO1 I2C SDA: Populate (0R) R7 and do not Populate (0R) R8.
30	MCU pin shared by signals from DIM: 40 & DIM: 100	PA13	PFC FAULT1 (DIM:40) or XPRO1 I2C SCL (DIM: 100)	By default (0R) R10 is populated for PFC FAULT1 Signal. For PFC FAULT1: Populate (0R) R10 and do not Populate (0R) R9. For XPRO1 I2C SCL: Populate (0R) R9 and do not Populate (0R) R10.
31	DIM: 3	PA14	Motor 1 Phase A Low Side PWM	Direct Connection
32	DIM: 7	PA15	Motor 1 Phase B Low Side PWM	Direct Connection
33	DIM:61 to DIM:64, DIM:117 to DIM:120	GND	GND	Digital Power Ground
34	DIM:57 to DIM:60, DIM:113 to DIM:116	VDDIO	VDD	VDD, Digital Power
35	DIM: 4	PA16	Motor 1 Phase C Low Side PWM	Direct Connection
36	DIM: 43	PA17	Motor 1 Fault2 Signal	Direct Connection
37	DIM: 41	PA18	Motor 1 Fault1 Signal	Direct Connection
38	DIM: 86	PA19	XPRO1 GPIO1 Signal	Direct Connection
39	DIM: 34	PB16	Motor 1 Button1 Signal	Direct Connection
40	DIM: 56	PB17	DEBUG_GPIO1 Signal	Direct Connection
41	DIM: 93	PA20	BLDC Speed Feedback Signal	Direct Connection; Pulse Speed feedback signal to MCU from external motor like BLDC Fan.
42	DIM: 79	PA21	Motor 1 Reference Pulse Input Signal	Direct Connection; Reference signal from external circuit to MCU if Potentiomenter is not used.
43	DIM: 52	PA22	DEBUG Transmit Signal	Direct Connection
44	DIM: 54	PA23	DEBUG Receive Signal	Direct Connection

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Device Pin#	DIM Pin#	SAM C21 Pad Name	Signal Name	Remarks
45	DIM: 97	PA24	BLDC Speed Reference Signal	Direct Connection; Pulse reference signal to control additional external motor like BLDC Fan.
46	DIM: 67	PA25	FG Speed Output Signal	Direct Connection; Pulse Speed feedback from MCU to external Main controller (Opional).
47	DIM:61 to DIM:64, DIM:117 to DIM:120	GND	GND	Digital Power Ground
48	DIM:57 to DIM:60, DIM:113 to DIM:116	VDDIO	VDD	VDD; Digital Power
49	DIM: 108	PB22	SPI MOSI Signal	Connected via 0R (R19) resistor; by default (0R) R19 is not populated.
50	DIM: 99	PB23	Motor 1 Button3 Signal	Direct Connection
51	DIM: 38	PA27	Relay Precharge Signal	Direct Connection; And this signal is pulled down with resistor 4.7k(R15).
52	DIM: 47	RESETn	MCU Reset Pin	Direct Connection
53	DIM: 70	PA28	Hall C Input Signal	Direct Connection
54	DIM:61 to DIM:64, DIM:117 to DIM:120	GND	VDD	VDD; Digital Power (VDD)
55	-	VDDCORE	VDDCORE	Serves as Internal Voltage regulator output.
56	DIM:57 to DIM:60, DIM:113 to DIM:116	VDDIN	VDDIN	Digital Power (VDD)
57	DIM: 51	PA30(SWCLK)	SWCLK	Programmer/Debugger SWCLK line
58	DIM: 50	PA31(SWDIO)	SWDIO	Programmer/Debugger SWDIO line
59	DIM: 1	PB30	Motor 1 Phase A High Side PWM	Direct Connection
60	DIM: 36	PB31	Motor 1 Button2 Signal	Direct Connection
61	DIM: 28	PB00	MOTOR1 Potentiometer Signal	Direct Connection
62	MCU pin shared by signals from DIM: 80 & DIM: 112	PB01	XPRO1 ID	DIM: 80: Direct Connection for XPRO1 ID signal DIM: 112 via 0R (R21). By default (0R) R21 is not populated.
63	MCU pin shared by signals from DIM: 85 & DIM: 110	PB02	RELAY ACIM CTRL	DIM: 85: Direct Connection for RELAY ACIM CTRL signal DIM: 110 via 0R (R20). By default (0R) R20 is not populated.
64	MCU pin shared by signals from DIM: 84 & DIM: 106	PB03	XPRO1 ADC (-)	DIM: 84: Direct Connection for XPRO1 ADC (-) signal and DIM: 106 via 0R (R18). By default (0R) R18 is not Populated.

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The following table provides the pin mapping from the DIM interface connector to the 64-pin ATSAMC21J18A device.

Table 1-2. Pin Mapping - DIM Interface Connector to the ATSAMC21J18A (Sorted by DIM Pin Number)

DIM Pin#	Device Pin#	SAM C21 Pad Name	DIM Signal Name	Remarks
1	59	PB30	Motor 1 Phase A High Side PWM	Direct Connection
2	19	PA10	Motor 1 Phase C High Side PWM	Direct Connection
3	31	PA14	Motor 1 Phase A Low Side PWM	Direct Connection
4	35	PA16	Motor 1 Phase C Low Side PWM	Direct Connection
5	14	PA05	Motor 1 Phase B High Side PWM	Direct Connection
6	29	PA12	PFC PWM	Sharing the MCU pin with the XPRO1 I2C SDA (DIM: 98). By default 0R (R8) is populated for PFC PWM Signal. For PFC PWM: Populate 0R (R8) and Do not Populate 0R(R7). For XPRO1 I2C SDA: Populate 0R (R7) and Do not Populate 0R (R8).
7	32	PA15	Motor 1 Phase B Low Side PWM	Direct Connection
8	23	PB10	PFC Enable	Direct Connection
9	3	PA02	MOTOR1 Phase A BEMF Voltage	Direct Connection
10	10 & 15	PB07 & PA06	PFC VAC	Sharing the MCU pin with the BEMF Neutral Signal (DIM: 69) Redundant selection with 0R (R3 and R4) resistors and J3; (Please note, will be corrected in the next revision with either selection with resistors or Jumper). Populate both 0R (R3) and 0R (R4). Select J3 Setting: 1and 2 for PFC VAC. Select J3 Setting: 2 and 3 for BEMF Neutral. **Note:** J3 output goes to PB07 and PA06 as they are connected together.
11	4	PA03	MOTOR1 Phase B BEMF Voltage	Direct Connection
12	13	PA04	PFC DC Link Current	Direct Connection
13 to 18	-	-	-	No Connection
19	11	PB08	Motor 1 Phase A current from external OPAMP	Direct Connection
20	16	PA07	Motor 1 Phase C current from external OPAMP	Sharing the MCU pin with the IPM Temperature Signal (DIM: 24) By default 0R (R2) is populated for IPM Temperature signal. For Motor 1 Phase C Current: Populate 0R (R1) and Do not Populate 0R (R2). For IPM Temp: populate 0R (R2) and Do not populate 0R (R1).
21	-	-	-	No Connection
22	6	PB05	MOTOR1 Phase C BEMF Voltage	Direct Connection
23	-	-	-	No Connection
24	16	PA07	IPM Temperature Signal	Sharing the MCU pin with the Motor 1 Phase Current C (DIM: 20). By default 0R (R2) is populated for IPM Temperature signal. For Motor 1 Phase C Current: Populate 0R (R1) and Do not Populate 0R (R2). For IPM Temp: Populate 0R (R2) and Do not Populate 0R (R1).
25	-	-	-	No Connection

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DIM Pin#	Device Pin#	SAM C21 Pad Name	DIM Signal Name	Remarks
26	20	PA11	External Temperature (EXT_TEMP1) Signal	Sharing the MCU pin with the XPRO1 ADC(+) signal (DIM: 82). By default 0R (R6) is populated for XPRO1 ADC(+) signal. For External Temperature 1: Populate 0R (R5) and Do not Populate 0R (R6). For XPRO1 ADC(+): Populate 0R (R6) and Do not Populate 0R (R5).
27	12	PB09	Motor 1 Phase B current from external OPAMP	Direct Connection
28	61	PB00	MOTOR1 Potentiometer Signal	Direct Connection
29	-	-	-	No Connection
30	25	PB12	LED1	Direct Connection
31	-	-	-	No Connection
32	26	PB13	LED2	Direct Connection
33	-	-	-	No Connection
34	39	PB16	Motor 1 Button 1 Signal	Direct Connection
35	17	PA08	MOTOR1 DC Link Current IBUS	Direct Connection
36	60	PB31	Motor 1 Button 2 Signal	Direct Connection
37	-	-	-	No Connection
38	51	PA27	RELAY PRECHARGE	Direct Connection: Generally used to precharge relays which helps to limit inrush current limit in High Voltage operations. Also connected with pull-down resistor 4.7k (R15).
39	18	PA09	Motor 1 DC Link Voltage VBUS Input	Direct Connection
40	30	PA13	PFC FAULT1	Sharing the MCU pin with the XPRO I2C SCL (DIM:100). By default 0R (R10) is populated for PFC FAULT1 Signal. For XPRO1 I2C SCL: Populate 0R (R9) and do not populate 0R (R10). For PFC FAULT1: populate 0R (R10) and do not populate 0R (R9).
41	37	PA18	Motor 1 FAULT 1 Signal	Direct Connection
42	-	-	-	No Connection
43	36	PA17	Motor 1 FAULT 2 Signal	Direct Connection
44	-	-	-	No Connection
45	-	-	-	No Connection
46	-	-	-	No Connection
47	52	MCLRn	MCU Reset Pin	Direct Connection
48	-	-	-	No Connection
49	-	-	-	No Connection
50	58	PA31	Programmer/Debugger SWDIO line	Direct Connection
51	57	PA30	Programmer/Debugger SWCLK line	Direct Connection
52	43	PA22	DEBUG Transmit Signal	Direct Connection
53	-	-	-	No Connection
54	44	PA23	DEBUG Receive Signal	Direct Connection
55	-	-	VCC SELECT Line	Select 5V or 3.3 V by using Jumper J2. J2 (2 &3): For 5V operation J2 (1&2): For 3.3V operation.
56	40	PB17	DEBUG GPIO1 pin	Direct Connection
57 to 60	21;34;48;56	VDD	Digital Power (VDD)	Digital Power (VDD)

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DIM Pin#	Device Pin#	SAM C21 Pad Name	DIM Signal Name	Remarks
61 to 64	22;33;47;54	GND	Digital Ground (GND)	Digital Ground (GND)
65	-	-	-	No Connection
66	24	PB11	Hall A Input Signal	Direct Connection
67	46	PA25	BREAKE PWM or FG SPEEDOUT	Direct Connection; PWM Dynamic Braking or Pulse Frequency Generator (Speed) to external control.
68	5	PB04	Hall B Input Signal	Direct Connection
69	10 & 15	PB07 & PA06	BEMF NEUTRAL Signal	Sharing the MCU pin with the PFC VAC (DIM: 10) Redundant selection with 0R (R3 and R4) resitors and J3 (Please note, will be corrected in the next revision with either selection with resistors or Jumper). Populate both 0R (R3) and 0R (R4). Select J3 Setting: 1 and 2 for PFC VAC and select J3 Setting: 2 and 3 for BEMF Neutral. **Note:** J3 output goes to PB07 and PA06 as they are connected together.
70	53	PA28	Hall C Input Signal	Direct Connection
71 to 78	-	-	-	No Connection
79	42	PA21	XPRO2_ID or REF PULSE	Direct Connection; Reference signal from external circuit to MCU if Potentiometer is not used.
80	62	PB01	XPRO1 ID	Connected to DIM: 80 directly for XPRO1 ID signal and also connected to DIM: 112 via 0R (R21). By default 0R (R21) is not populated;
81	-	-	-	No Connection
82	20	PA11	XPRO1 ADC(+)	Sharing the MCU pin with the EXT TEMP1 (DIM: 26) By default 0R (R6) is populated for XPRO1 ADC(+) signal. For External Temperature 1: Populate 0R (R5) and do not populate 0R (R6). For XPRO1 ADC(+): Populate 0R (R6) and do not populate 0R (R5).
83	-	-	-	No Connection
84	64	PB03	XPRO1 ADC(-)	Connected to DIM: 84 directly for XPRO1 ADC (-) signal and also connected to DIM: 106 via 0R (R18). By default 0R (R18) is not populated.
85	63	PB02	RELAY ACIM CTRL	Connected to DIM: 85 directly for RELAY ACIM CTRL signal and connected to DIM: 110 via 0R (R20); By default 0R (R20) is not populated.
86	38	PA19	XPRO1 GPIO1	Direct Connection
87	-	-		No Connection
88	9	PB06	XPRO1 GPIO2	Direct Connection
89 to 92	-	-	-	No Connection
93	41	PA20	BLDC SPEED Feedback or XPRO2 IRQ	Direct Connection; Pulse Speed feedback signal to MCU from external motor like BLDC Fan.
94 to 96	-	-	-	No Connection
97	45	PA24	BLDC SPEED REF	Direct Connection. Pulse reference signal to control additional external motor like BLDC Fan.
98	29	PA12	XPRO1 I2C SDA	Sharing the MCU pin with the PFC PWM (Signal from DIM: 6). By default 0R (R8) is populated for PFC PWM Signal. For PFC PWM: Populate 0R (R8) and do not populate 0R(R7). For XPRO1 I2C SDA: Populate 0R (R7) and do not populate 0R (R8).
99	50	PB23	Motor 1 Button 3 Signal	Direct Connection

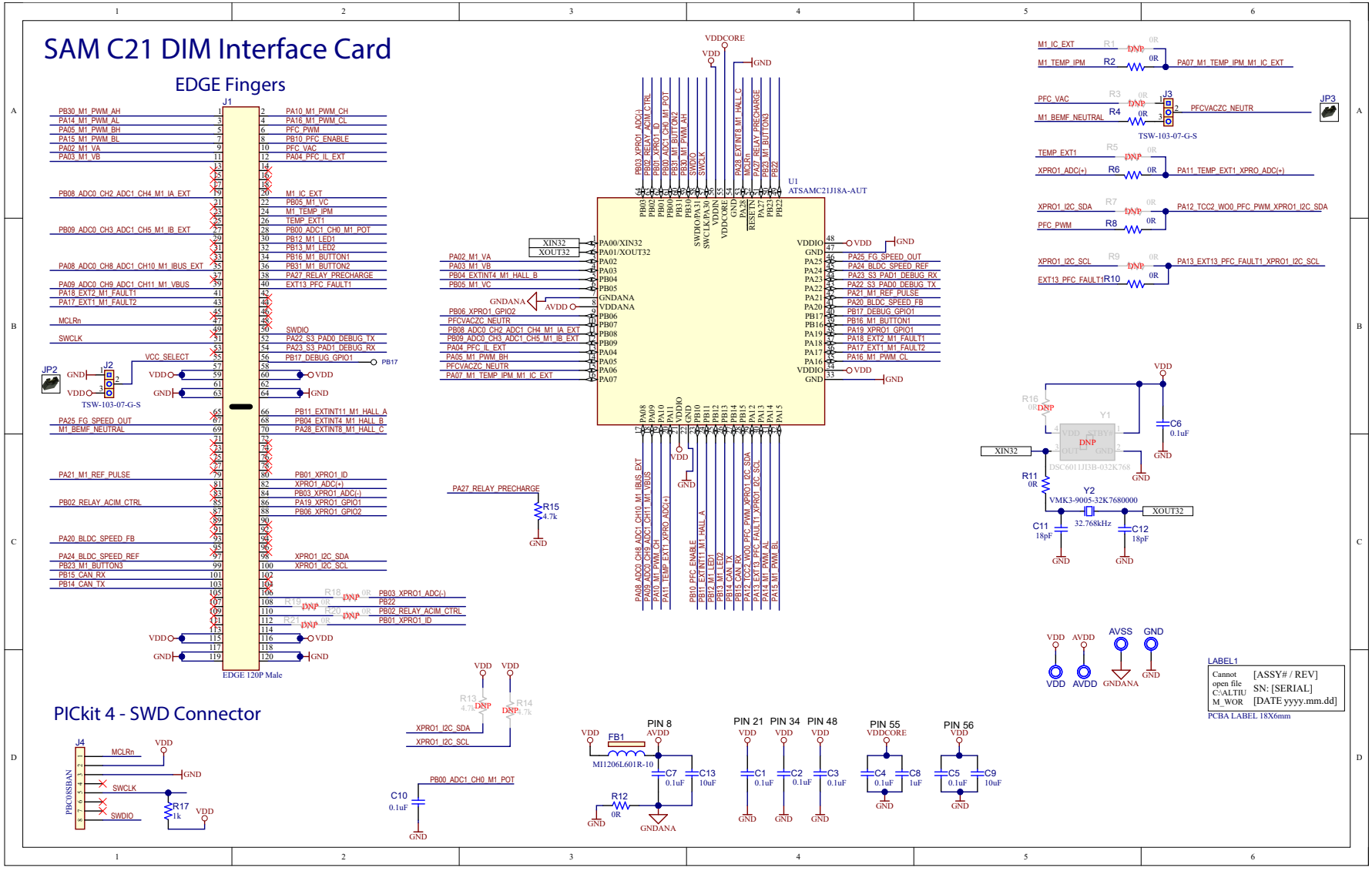
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DIM Pin#	Device Pin#	SAM C21 Pad Name	DIM Signal Name	Remarks
100	30	PA13	XPRO1 I2C SCL	Sharing the MCU pin with the PFC FAULT1 Input (DIM: 40). By default 0R (R10) is populated for PFC FAULT1 Signal; For XPRO1 I2C SCL: Populate 0R (R9) and Do not Populate 0R (R10); For PFC FAULT1: Populate 0R (R10) and do not populate 0R (R9).
101	28	PB15	XPRO2 UART Receive or CAN Receive Signal	Direct Connection
102	-	-	-	No Connection
103	27	PB14	XPRO2 UART Transmit or CAN Transmit Signal	Direct Connection
104 & 105	-	-	-	No Connection
106	64	PB03	XPRO1 SPI SS	Connected to DIM: 84 directly for XPRO1 ADC (-) signal and connected to DIM: 106 via 0R (R18). By default 0R (R18) is not populated.
107	-	-	-	No Connection
108	49	PB22	XPRO1 SPI MOSI	Connected via 0R (R19) resistor to MCU Pin. 0R (R19) is not populated;
109	-	-	-	No Connection
110	63	PB02	XPRO1 SPI MISO	Connected to DIM: 85 directly for RELAY ACIM CTRL signal and connected to DIM: 110 via 0R (R20). By default 0R (R20) is not populated.
111	-	-	-	No Connection
112	62	PB01	XPRO1 SPI SCK	Connected to DIM: 80 directly for XPRO1 ID signal and connected to DIM: 112 via 0R (R21). By default 0R (R21) is not populated.
113 to 116	21;34;48;56	VDD	Digital Power (VDD)	Direct Connection
117 to 120	22;33;47;54	GND	Digital Ground (GND)	Direct Connection

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2. Schematics



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