AP21X1A-EVM User Guide

Single-Channel Current-Limited Power Switch

General Description

The AP21X1A and AP21X1AD are integrated high-side power switches optimized for Universal Serial Bus (USB) and other hot-swap applications. The family of devices complies with USB 2.0 and is available with both polarities of Enable input. They offer current and thermal limiting and short circuit protection, as well as controlled rise time and undervoltage lockout functionality. A 7ms deglitch capability on the open-drain Flag output prevents false overcurrent reporting and does not require any external components.

Applications

- Consumer electronics – LCD TVs & monitors, game machines
- Communications – set-top-boxes, GPS, smartphones
- Computing – laptops, desktops, servers, printers, docking stations, HUBs

Key Features

- Single USB Port Power Switches with Output Discharge
- Overcurrent and Thermal Protection
- 0.8A accurate Current Limiting
- Fast Transient Response
- Reverse Current Blocking
- 90mΩ On-Resistance
- Input Voltage Range: 2.7V - 5.5V
- 0.6ms Typical Rise Time
- Very Low Shutdown Current: 1μA (max)
- Fault Report (FLG) with Blanking Time (7ms typ)
- ESD Protection: 4kV HBM, 300V MM
- Active High (ex. AP2191A/AP2191D) or Active Low (ex. AP2181A/AP2181D) Enable
- Ambient Temperature Range -40°C to +85°C
- SOT25, SO-8, MSOP-8EP (Exposed Pad), and U-DFN2018-6: Available in "Green" Molding Compound (No Br, Sb)
  - **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
  - **Halogen and Antimony Free. "Green" Device (Note 3)**
- 15kV ESD Protection per IEC 61000-4-2 (with external capacitance)
- UL Recognized, File Number E322375
- IEC60950-1 CB Scheme Certified

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Applications Circuit

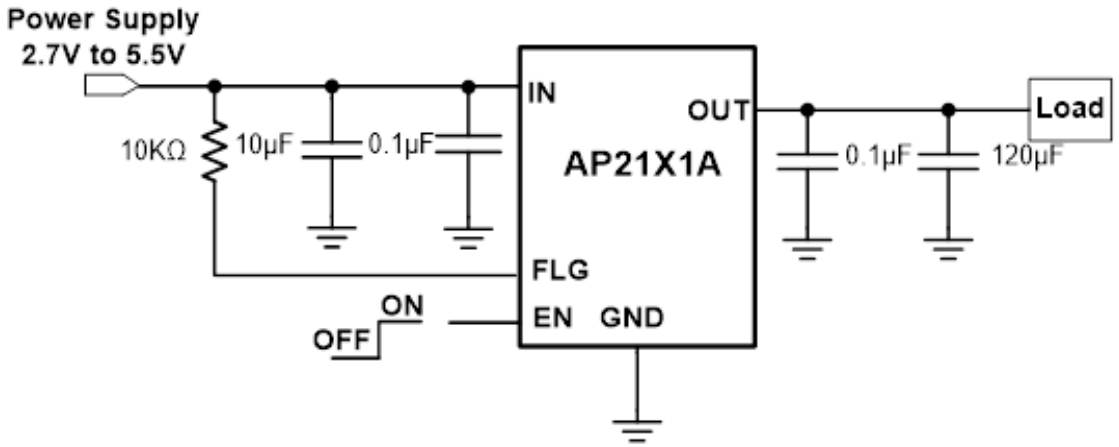

Figure 1: Typical Applications Circuit

Recommended Operating Conditions

Symbol	Characteristic	Min	Max	Rating	Unit
V_{IN}	Input Voltage	2.7	5.5	6.5	V
V_{OUT}	Output Voltage	-	-	VIN + 0.3	V
V_{EN}, V_{FLG}	Enable and Flag Voltage	-	-	6.5	V
I_{LOAD}	Maximum Continuous Load Current	-	-	1.5	A
T_A	Operating Ambient Temperature	-40	+85	+150	ºC

Ordering Information

Device	Package Code	Output Current (A)	Enable	Package	EVM Part Number
AP2181AW-7	W	1.5	Low	SOT25	AP21X1AW-EVM
AP2181AS-13	S	1.5	Low	SOP-8	AP21X1AS-EVM
AP2181AMP-13	MP	1.5	Low	MSOP8-EP	AP21X1AMP-EVM
AP2181AFM-7	FM	1.5	Low	U-DFN2018-6	AP21X1AFM-EVM
AP2191AW-7	W	1.5	High	SOT25	AP21X1AW-EVM
AP2191AS-13	S	1.5	High	SOP-8	AP21X1AS-EVM
AP2191AMP-13	MP	1.5	High	MSOP8-EP	AP21X1AMP-EVM
AP2191AFM-7	FM	1.5	High	U-DFN2018-6	AP21X1AFM-EVM
AP2181DWG-7	W	1.5	Low	SOT25	AP21X1AW-EVM
AP2181DSG-13	S	1.5	Low	SOP-8	AP21X1AS-EVM
AP2181DM8G-13	MP	1.5	Low	MSOP8	AP21X1AMP-EVM
AP2181DMPG-13	MP	1.5	Low	MSOP8-EP	AP21X1AMP-EVM
AP2181DFMG-7	FM	1.5	Low	U-DFN2018-6	AP21X1AFM-EVM
AP2191DWG-7	W	1.5	High	SOT25	AP21X1AW-EVM
AP2191DSG-13	S	1.5	High	SOP-8	AP21X1AS-EVM
AP2191DM8G-13	MP	1.5	High	MSOP8	AP21X1AMP-EVM
AP2191DMPG-13	MP	1.5	High	MSOP8-EP	AP21X1AMP-EVM
AP2191DFMG-7	FM	1.5	High	U-DFN2018-6	AP21X1AFM-EVM

Evaluation Board

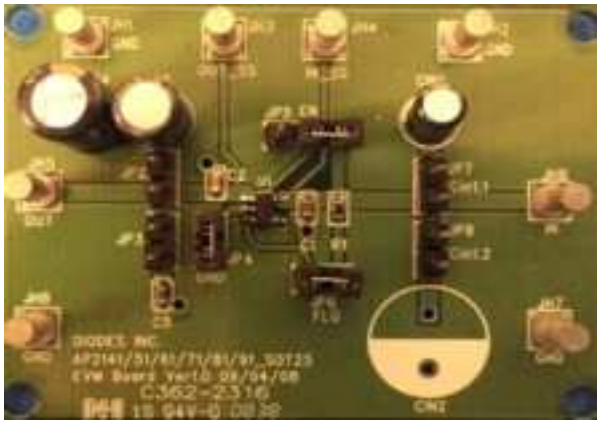

Figure 1. AP21X1AW-EVM

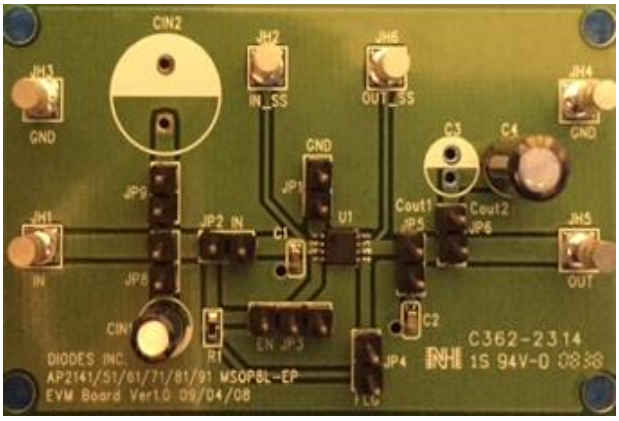

Figure 2. AP21X1AMP-EVM

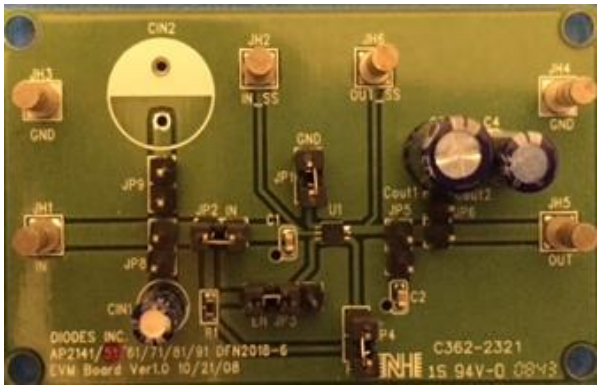

Figure 3. AP21X1AFM-EVM

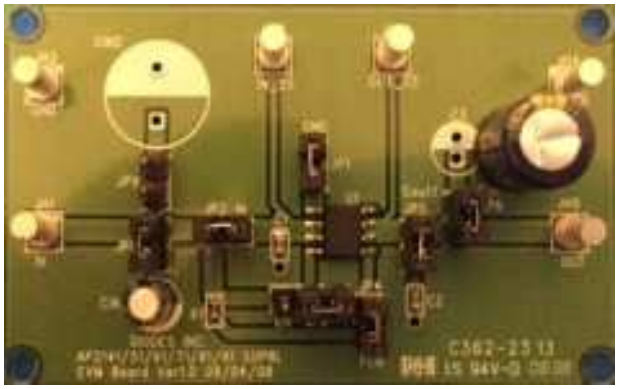

Figure 4. AP21X1AS-EVM

Figure 5. AP21X1AW-EVM

Figure 6. AP21X1AMP-EVM

Evaluation Board (continued)

Figure 7. AP21X1AS-EVM

Figure 8. AP21X1AFM-EVM

Quick Start Guide

1. Insert jumpers to configure the input capacitance and output capacitance as described in the Application Information sections of the device datasheet.
2. Place the Enable jumper in the enable position.
3. Connect a +5V power supply between the IN and GND terminals. Make sure the power supply is turned off.
4. Connect an adjustable current or resistive load to the OUT and GND terminals.
5. Turn on the power supply.
6. Increase the load current and observe that the load current will stop increasing after reaching certain level. That is an indication that the device is limiting the load current.
7. Use an oscilloscope or a voltage meter to check that the FLG pin becomes low when the current limit is reached.

Evaluation Board Schematic

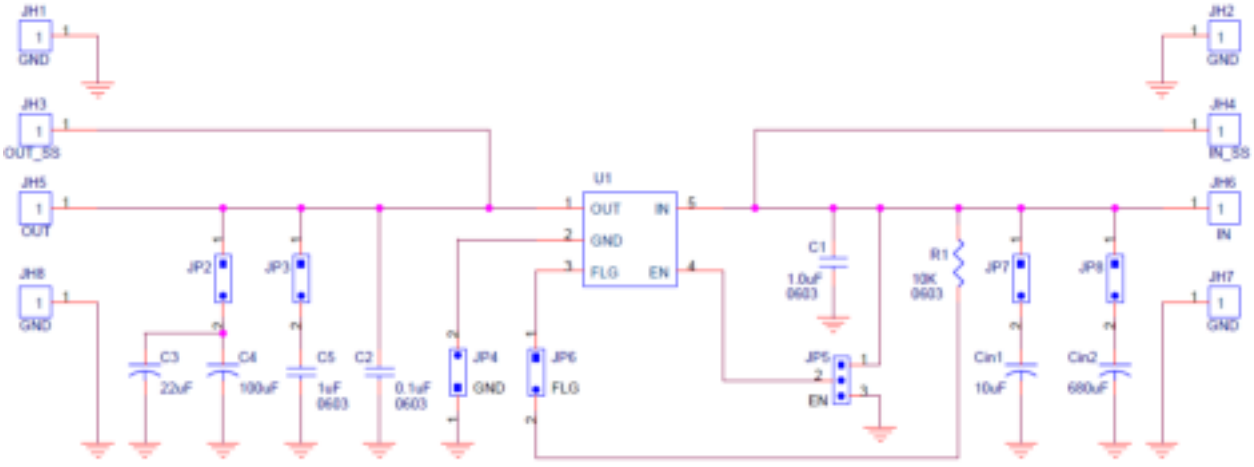

Figure 9. AP21X1AW-EVM

Evaluation Board Schematic (continued)

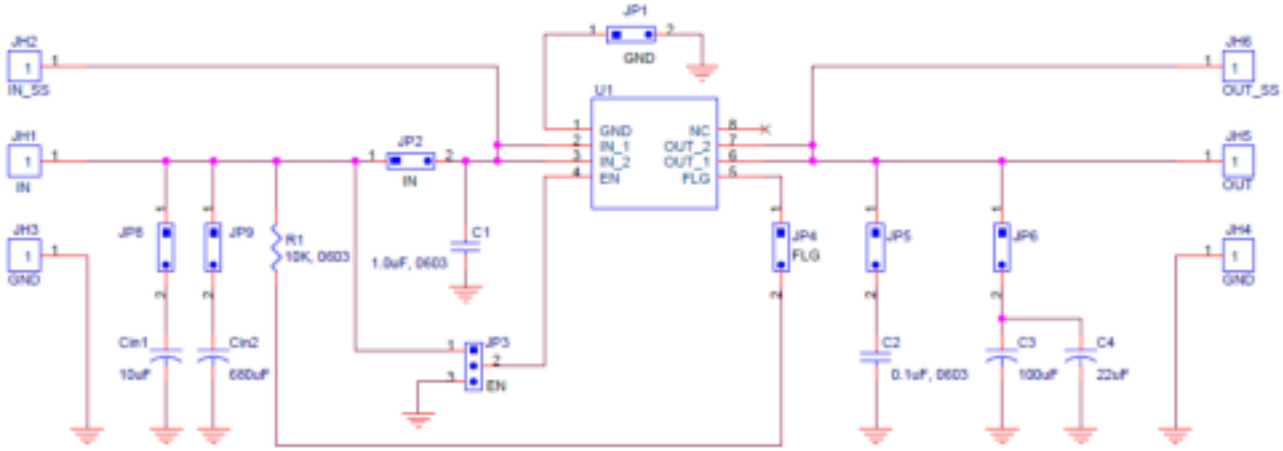

Figure 10. AP21X1AS-EVM & AP21X1AMPG-EVM

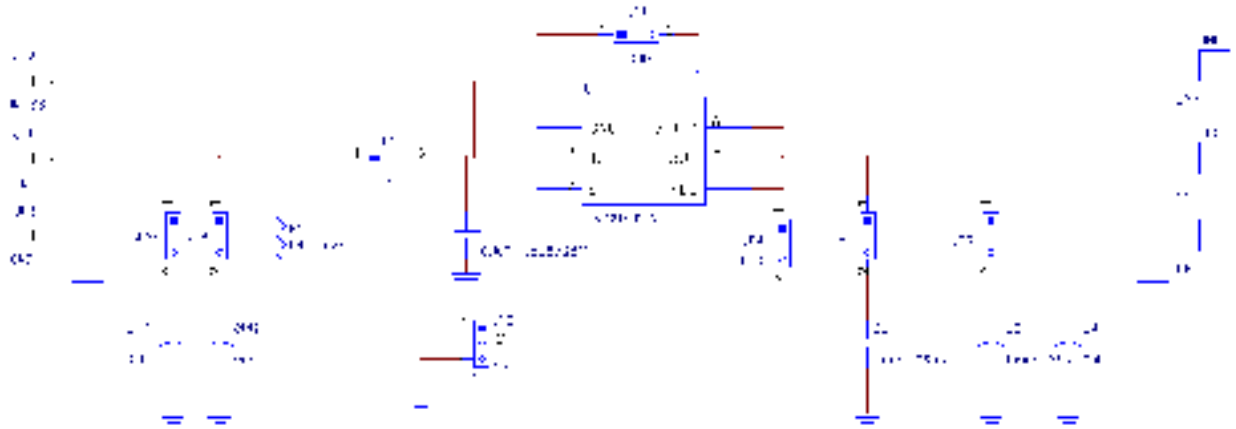

Figure 11. AP21X1AFM-EVM

Evaluation Board Schematic (continued)

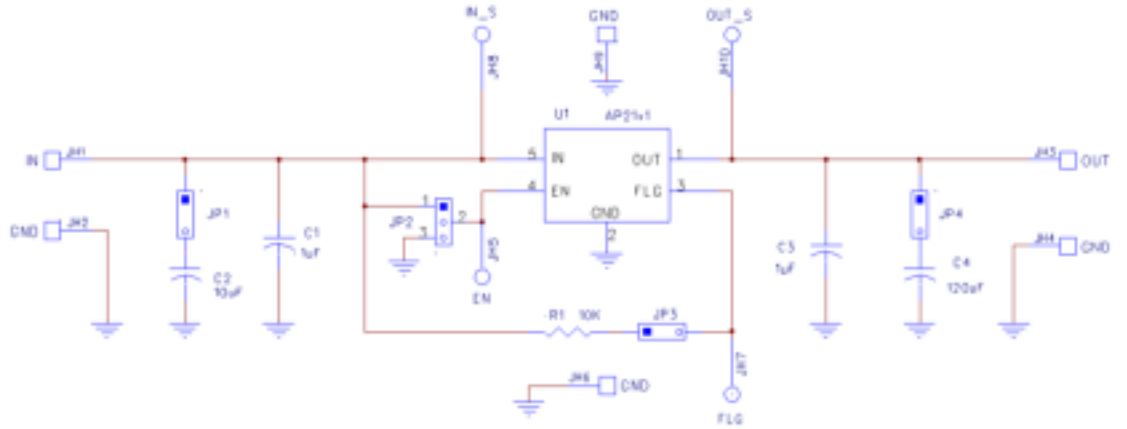

Figure 12. AP21X1AW-EVM

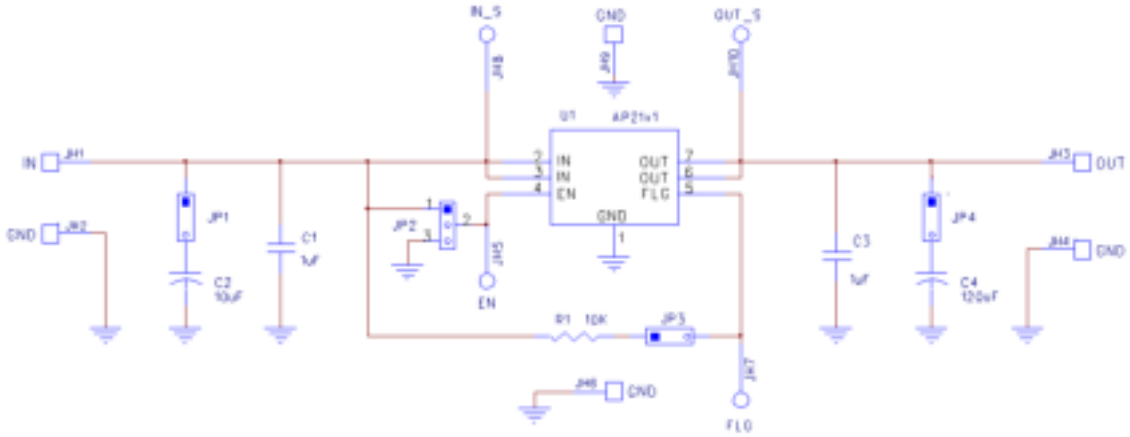

Figure 13. AP21X1AMP-EVM

Evaluation Board Schematic (continued)

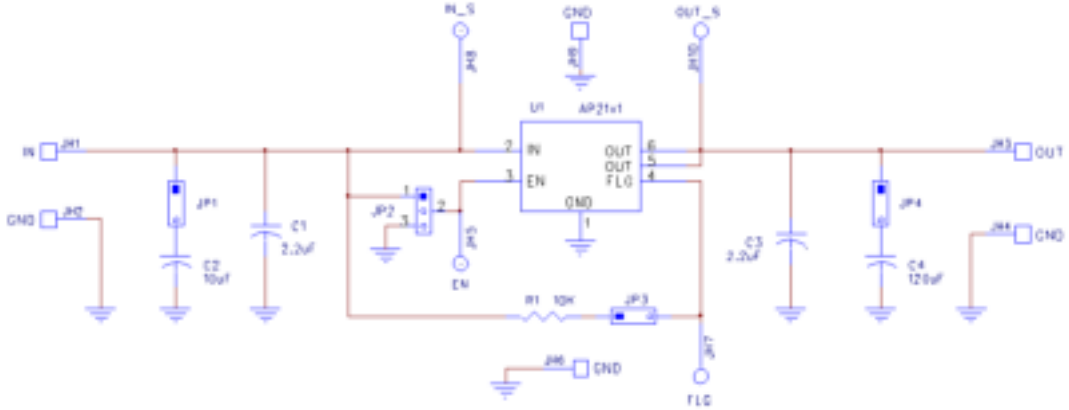

Figure 14. AP21X1AFM-EVM

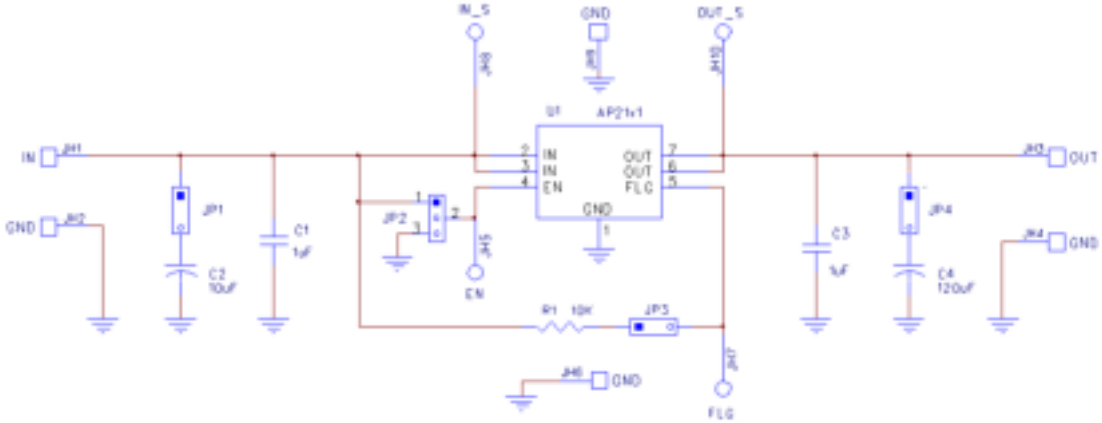

Figure 15. AP21X1AS-EVM

Bill Of Materials for AP21X1AW-EVM

Item	Qty	Reference	Value	Part #	Manufacturer	Description
1	3	C1, C2, C5	0.1μF	0603YC104KAT2A	AVX	Ceramic Capacitor, 0603, 16V, X7R, 10%
3	1	CIN1	10μF	EEA-FC1E100	STD/Panasonic	Electrolytic Capacitor
4	1	C4	120μF	EEU-FC1V121	STD/Panasonic	Electrolytic Capacitor, 35V
5	1	R1	10KΩ	ERJ-3EKF1002V	Panasonic	Resistor, 0603, 1%
6	1	JP5		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X3
7	6	JP2,JP3,JP4,JP6,JP7,JP8		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X2
8	8	JH1,JH2,JH3,JH4,JH5,JH6,JH7,JH8		1598-2	Keystone Electronics	Circuit Board Hardware - PCB TERM .094X1/16
9	1	U1		AP21X1AW-7	Diodes	AP21X1A, SOT25

Bill Of Materials for AP21X1AMP-EVM

Item	Qty	Reference	Value	Part #	Manufacturer	Description
1	2	C1, C2	0.1μF	0603YC104KAT2A	AVX	Ceramic Capacitor, 0603, 16V, X7R, 10%
2	1	CIN1	10μF	EEA-FC1E100	STD/Panasonic	Electrolytic Capacitor
3	1	C3	120μF	EEU-FC1V121	STD/Panasonic	Electrolytic Capacitor, 35V
4	1	R1	10KΩ	ERJ-3EKF1002V	Panasonic	Resistor, 0603, 1%
5	1	JP3		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X3
6	4	JP2,JP8,JP5,JP6		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X2
7	6	JH1,JH2,JH3,JH4,JH5,JH6		1598-2	Keystone Electronics	Circuit Board Hardware - PCB TERM .094X1/16
9	1	U1		AP21X1AMP-13	Diodes	AP21X1A, MSOP-EP

Bill Of Materials for AP21X1AFM-EVM

Item	Qty	Reference	Value	Part #	Manufacturer	Description
1	2	C1, C2	0.1μF	0603YC104KAT2A	AVX	Ceramic Capacitor, 0603, 16V, X7R, 10%
2	1	CIN1	10μF	EEA-FC1E100	STD/Panasonic	Electrolytic Capacitor
3	1	C3	120μF	EEU-FC1V121	STD/Panasonic	Electrolytic Capacitor, 25V
4	1	R1	10KΩ	ERJ-3EKF1002V	Panasonic	Resistor, 0603, 1%
5	1	JP3		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X3
6	6	JP1,JP2,JP4,JP5,JP6,JP8		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X2
7	6	JH1,JH2,JH3,JH4,JH5,JH6		1598-2	Keystone Electronics	Circuit Board Hardware - PCB TERM .094X1/16
9	1	U1		AP21X1AFM-7	Diodes	AP21X1A, DFN2018-6

Bill Of Materials for AP21X1AS-EVM

Item	Qty	Reference	Value	Part #	Manufacturer	Description
1	2	C1, C2	0.1µF	0603YC104KAT2A	AVX	Ceramic Capacitor, 0603, 16V, X7R, 10%
2	1	CIN1	10µF	EEA-FC1E100	STD/Panasonic	Electrolytic Capacitor
3	1	C3	120µF	EEU-FC1V121	STD/Panasonic	Electrolytic Capacitor, 35V
4	1	R1	10KΩ	ERJ-3EKF1002V	Panasonic	Resistor, 0603, 1%
5	1	JP3		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X3
6	4	JP2,JP8,JP5,JP6		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X2
7	6	JH1,JH2,JH3,JH4,JH5,JH6		1598-2	Keystone Electronics	Circuit Board Hardware - PCB TERM .094X1/16
9	1	U1		AP21X1AS-13	Diodes	AP21X1A, SOP8

Bill Of Materials for AP21X1AS/FM/W/MP-EVM

Item	Qty	Reference	Value	Part #	Manufacturer	Description
1	2	C1, C3	1µF	EMK107B7105KA-T	Taiyo Yuden	Ceramic Capacitor, 0603, 16V, X7R, 10%
2	1	C2	10µF	EEA-FC1E100	STD/Panasonic	Electrolytic Capacitor
3	1	C4	120µF	EEU-FC1V121B	STD/Panasonic	Electrolytic Capacitor
4	1	R1	10KΩ	ERJ-3EKF1002V	Panasonic	Resistor, 0603, 1%
5	1	JP2		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X3
6	3	JP1,JP3,JP4		2340-6211TG	3M	PCB Header, Straight 40 POS, 1X2
7	6	T1		1598-2	Keystone Electronics	Circuit Board Hardware - PCB TERM .094X1/16
8	4	T2		1573-2	Keystone Electronics	Circuit Board Hardware - PCB 3 Turret Term .082"
9	1	U1		AP21X1A	Diodes	AP21X1A

PCB Layout

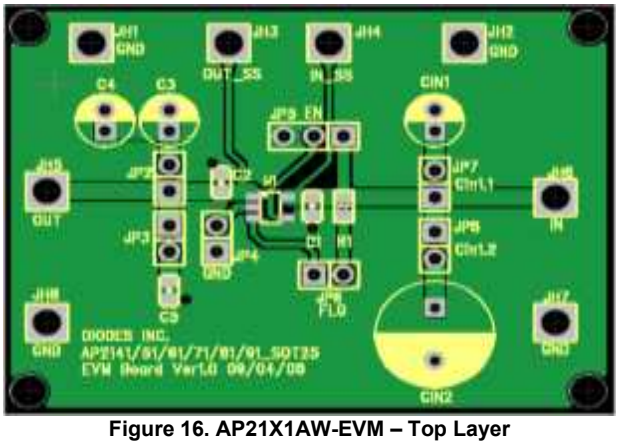

Figure 16. AP21X1AW-EVM – Top Layer

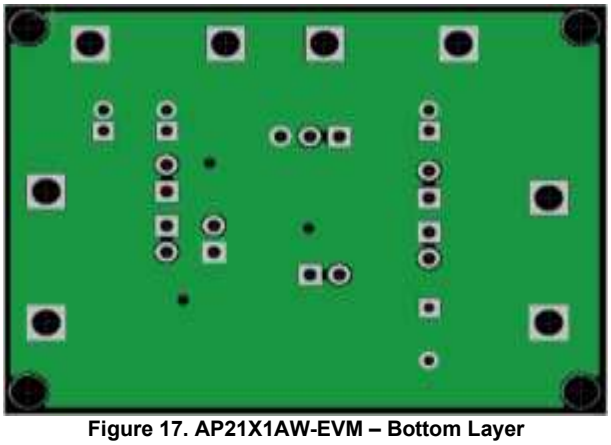

Figure 17. AP21X1AW-EVM – Bottom Layer

PCB Layout (continued)

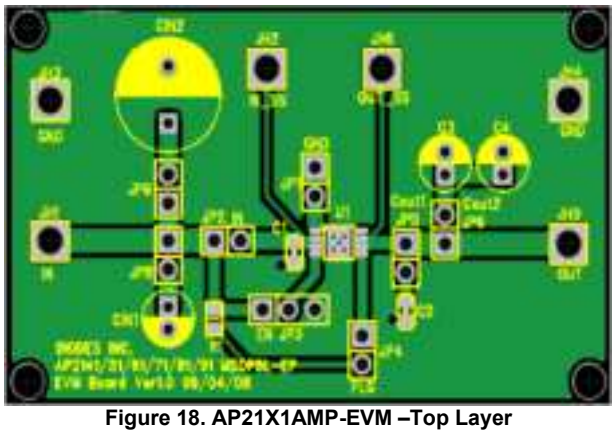

Figure 18. AP21X1AMP-EVM –Top Layer

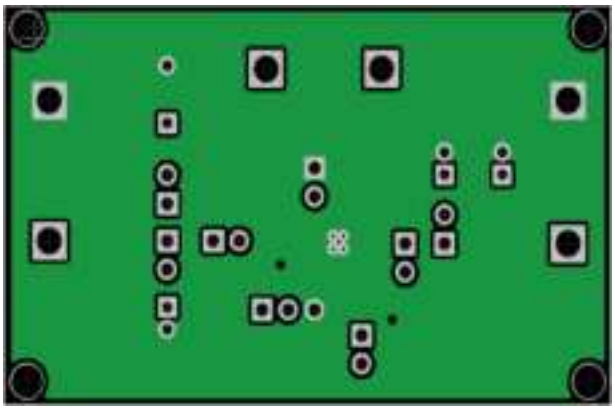

Figure 19. AP21X1AMP-EVM – Bottom Layer

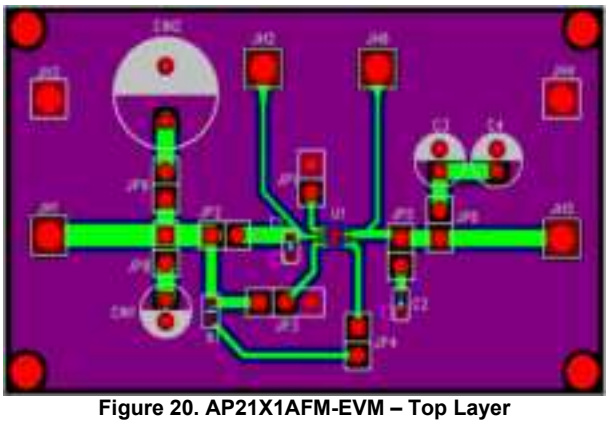

Figure 20. AP21X1AFM-EVM – Top Layer

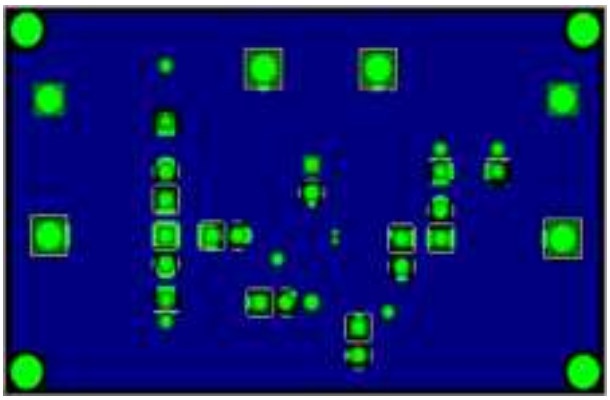

Figure 21. AP21X1AFM-EVM – Bottom Layer

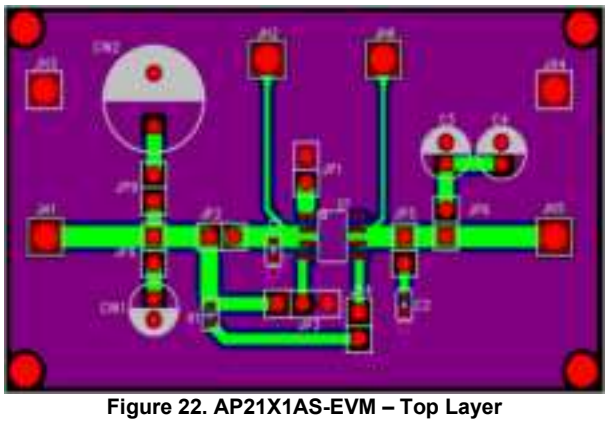

Figure 22. AP21X1AS-EVM – Top Layer

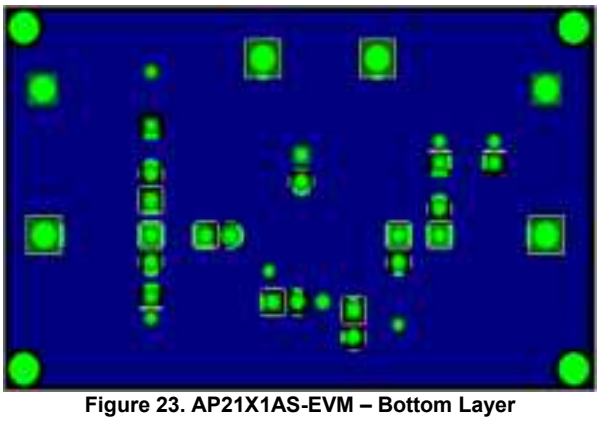

Figure 23. AP21X1AS-EVM – Bottom Layer

PCB Layout (continued)

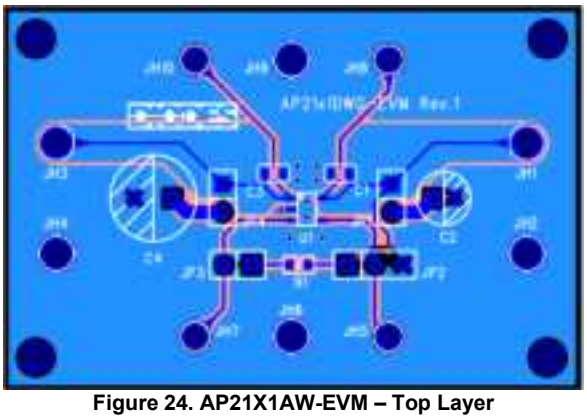

Figure 24. AP21X1AW-EVM – Top Layer

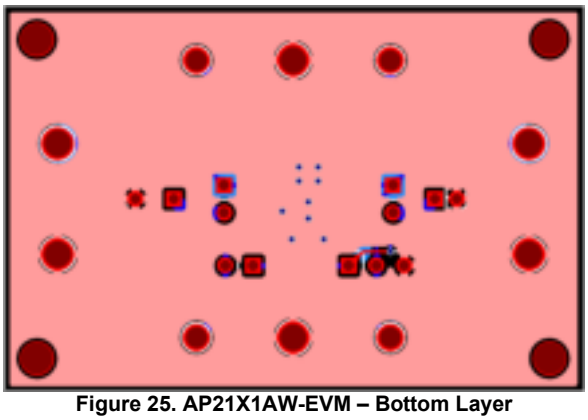

Figure 25. AP21X1AW-EVM – Bottom Layer

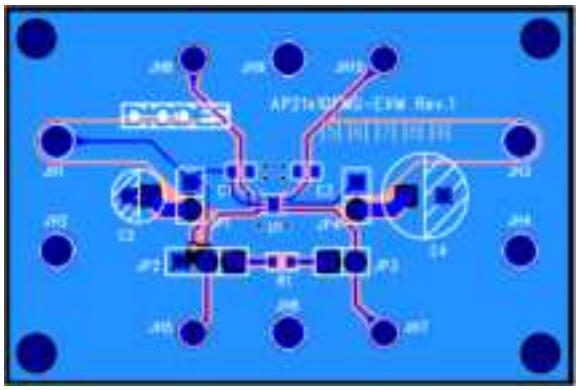

Figure 26. AP21X1AFM-EVM – Top Layer

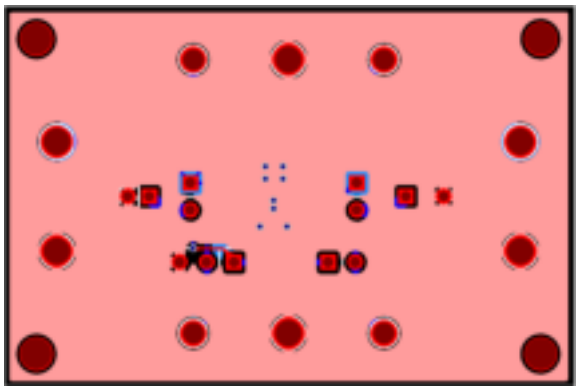

Figure 27. AP21X1AFM-EVM – Bottom Layer

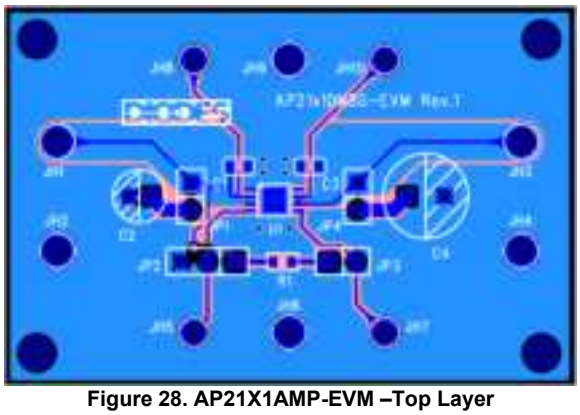

Figure 28. AP21X1AMP-EVM –Top Layer

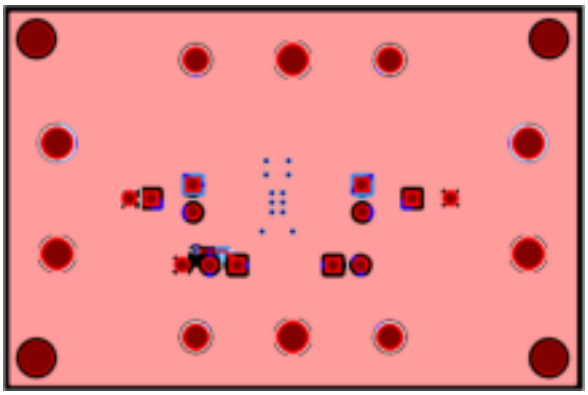

Figure 29. AP21X1AMP-EVM – Bottom Layer

PCB Layout (continued)

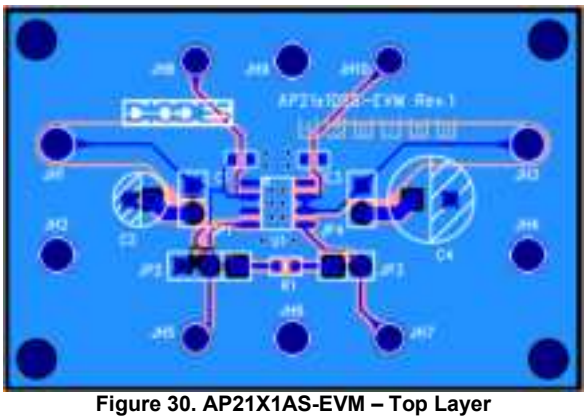

Figure 30. AP21X1AS-EVM – Top Layer

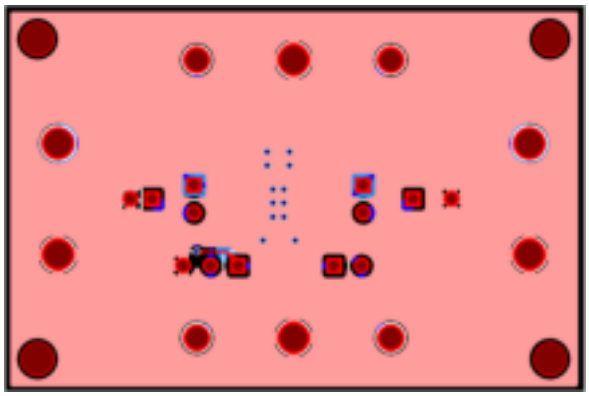

Figure 31. AP21X1AS-EVM – Bottom Layer

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