AP22615/AP22815-EVM

Application Note
AP22615/AP22815 Application Information and Demo Board User Guide

Description

The AP22815/615 is a 3A single channel current-limited high-side power switch with output OVP optimized for USB and other hot-swap applications which need to have over voltage protection from output to protection the system. The AP22815/615 complies with USB standards and is available with both polarities of Enable input. AP22815 supports fixed current-limited feature, while AP22615 equips adjustable current-limited feature optimized for applications that require precision current limiting support. It supports USB PD3.0 fast role swap function. The output voltage could recovery to USB valid voltage range within 110us during USB PD fast role swap event.

The device has fast short-circuit and output over-voltage response time for improved overall system robustness. Both TSOT25 and TSOT26 packages integrate discharge circuitry inside OUT pin. They provide a complete protection solution for applications subject to heavy capacitive loads and the prospect of short circuit, and offer output over-voltage protection, reverse current blocking, over-current, over-temperature and short-circuit protection, as well as controlled rise time and under-voltage lockout functionality. A 7ms deglitch capability on the open-drain Flag output prevents false over-current/over-voltage/over-temperature reporting and does not require any external components.

The AP22815 is available in a standard Green TSOT25 packages with RoHS compliant. The AP22615 is available in a standard Green TSOT26 packages with RoHS compliant.

Applications

- Integrated Load Switches in Ultrabook PC
- Power Up/Down Sequencing in Ultrabook PC
- Notebook, Netbook, Tablet PC, Set-Top Box
- SSD (Solid State Drives)
- Consumer Electronics
- USB Charger
- Telecom Systems

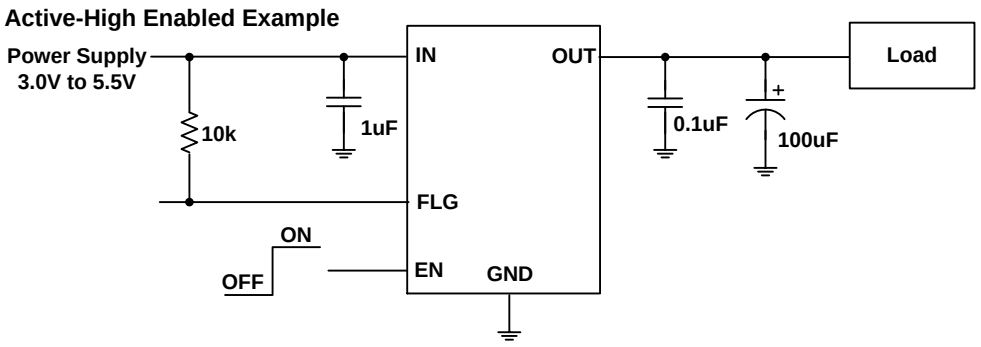
Features

- Input Voltage Range: 3.0V ~ 5.5V
- 40mΩ on-resistance
- Built-in soft-start with 2.1 ms typical rise time
- Fault report (FLG) with blanking time (7ms typ)
- Accurate Adjustable Current Limit, 0.4A~4.0A (AP22615 only)
- ESD protection: 2KV HBM, 200V MM
- Active low or active high enable
- Protection
  - Output Over-Voltage with Auto Recovery
  - Over Current with Auto Recovery
  - Short Circuit with Auto Recovery
  - Over temperature with Auto Recovery
- Output Reverse Voltage Protection
- Fast Role Swap function
- Thermally Efficient Low Profile Package
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. “Green” Device (Note 3)**
- UL Recognized, File Number E322375
- IEC60950-1 CB Scheme Certified

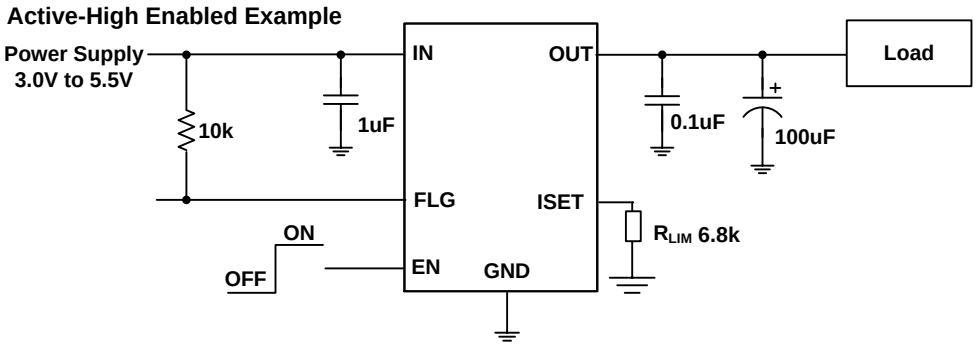
Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free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

Typical Applications Circuit

For AP22815



For AP22615



Note: If applying 1μF input capacitor will lead to large V_{IN} spike, it's recommended to use 10μF capacitor instead.

Absolute Maximum Ratings

Symbol	Parameter		Ratings	Units
ESD HBM	Human Body ESD Protection		2000	V
ESD MM	Machine Model ESD Protection		200	V
V_{IN}	Input Voltage		-0.3 to 6.0	V
V_{OUT}	Output Voltage (V_{OUT} to GND, V_{OUT} to V_{IN})		-0.3 to 28	V
V_{EN}	Enable Voltage		-0.3 to (V_{IN} +0.3)	V
V_{ISET}	ISET Voltage		-0.3 to (V_{IN} +0.3)	V
I_L	Load Current		Internal Limited	A
$T_{J(max)}$	Maximum Junction Temperature		150	°C
T_{ST}	Storage Temperature		-65 to +150	°C
$R_{\Theta JA}$	Thermal Resistance, Junction to Ambient	TSOT25	85	°C/W
		TSOT26	80	
$R_{\Theta JC}$	Thermal Resistance, Junction to Case	TSOT25	32	°C/W
		TSOT26	30	

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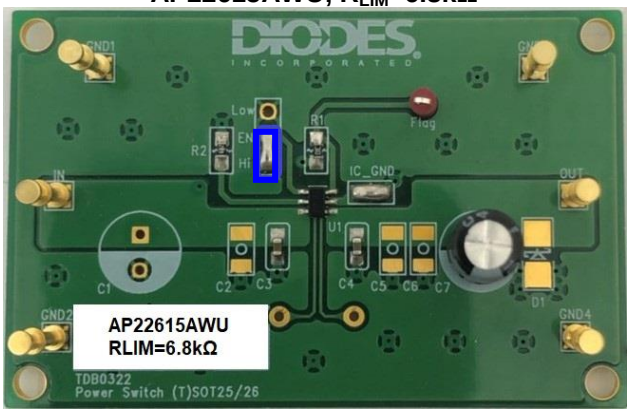
Recommended Operating Conditions

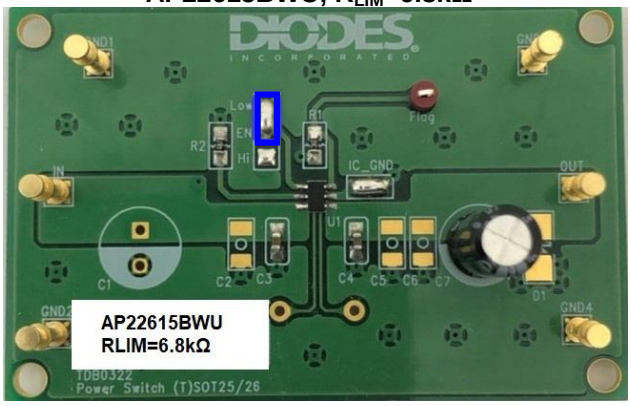
Symbol	Parameter	Min	Max	Unit
V_{IN}	Input voltage	3.0	5.5	V
I_{OUT}	Output Current, 4.0V ≤ Vin ≤ 5.5V	0	3	A
	Output Current, 3.0V ≤ Vin < 4.0V	0	1.5	A
V_{IL}	EN Input Logic Low Voltage	0	0.4	V
R_{LIM}	Current-Limit Threshold Resistor Range (1% initial tolerance)	1.94	6.8	kΩ
V_{OUT}	Output Voltage	0	23	V
V_{IH}	EN Input Logic High Voltage	1.2	V_{IN}	V
T_A	Operating Ambient Temperature	-40	+85	°C

Evaluation Board

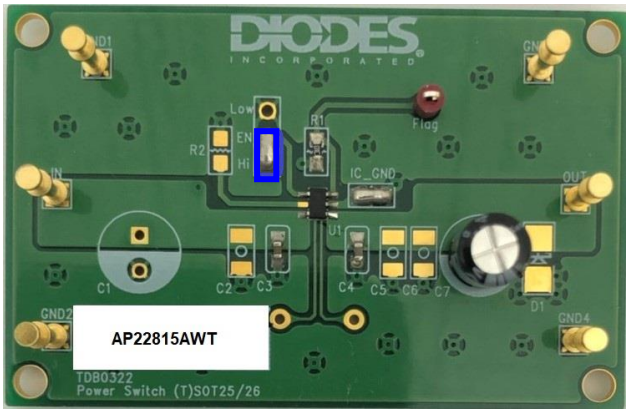
AP22615AWU, R_{LIM}=6.8kΩ



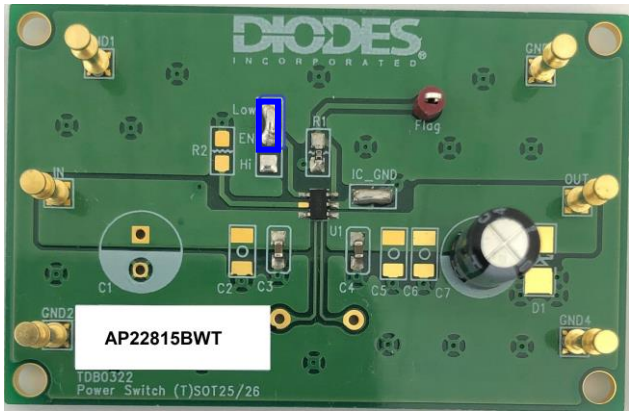
AP22615BWU, R_{LIM}=6.8kΩ



AP22815AWT



AP22815BWT



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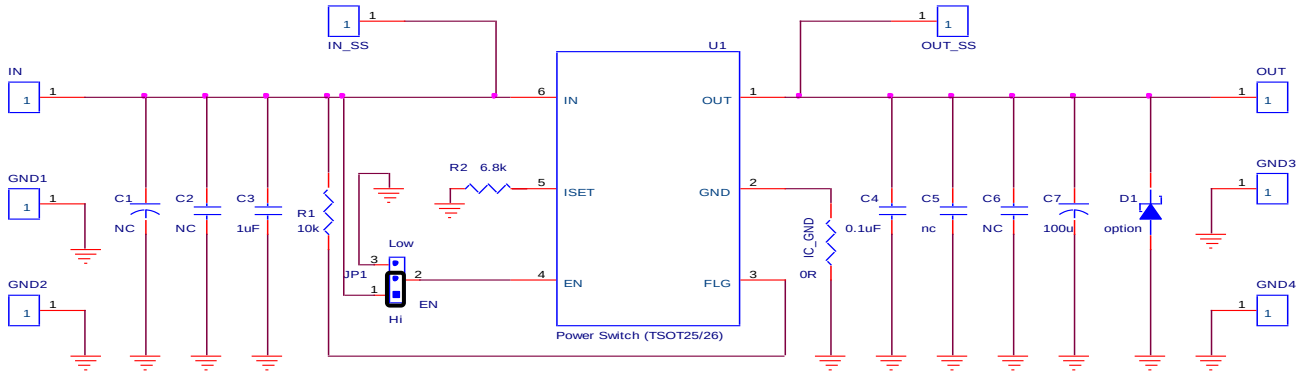
Quick Start Guide

The AP22615/AP22815(Power Switch) evaluation modules (EVM) provide a means for the user to evaluate quickly the functionality and electrical performance of the AP22615/AP22815 device. All inputs and outputs are brought out to test points for control and monitoring. All passive components are included on the EVM for device operation. The input pin should be connected to an external supply; the output should be connected to a load.

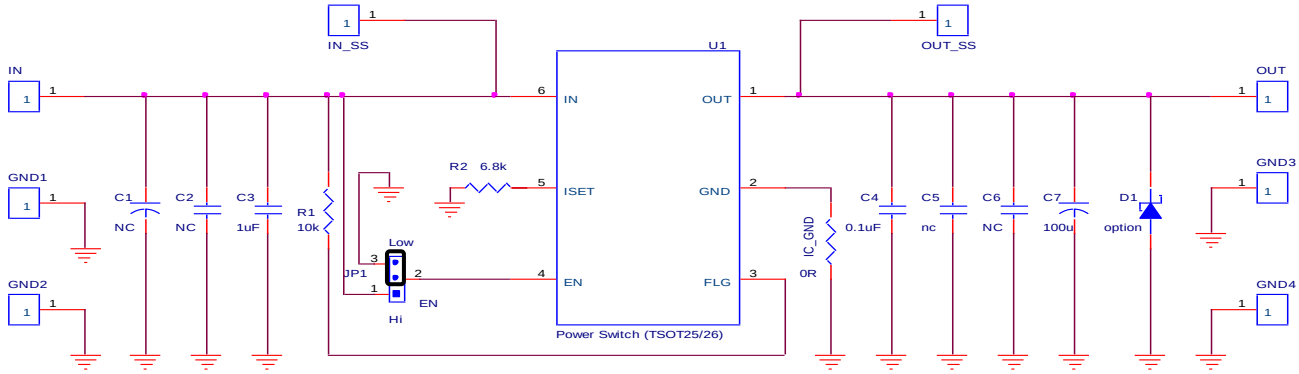
1. Connect a +5V power supply between IN and GND terminals.
2. Connect an adjustable current or resistive load to OUT1 and GND terminals.
3. Turn on the power supply.
4. Increase the load current of OUT and observe that the load current will stop increasing after reaching certain level. That is an indication that the device is limiting the load current.
5. Use an oscilloscope or a voltage meter to check that FLAG pin become low when the current limit is reached.

Evaluation Board Schematic

For AP22615AWU

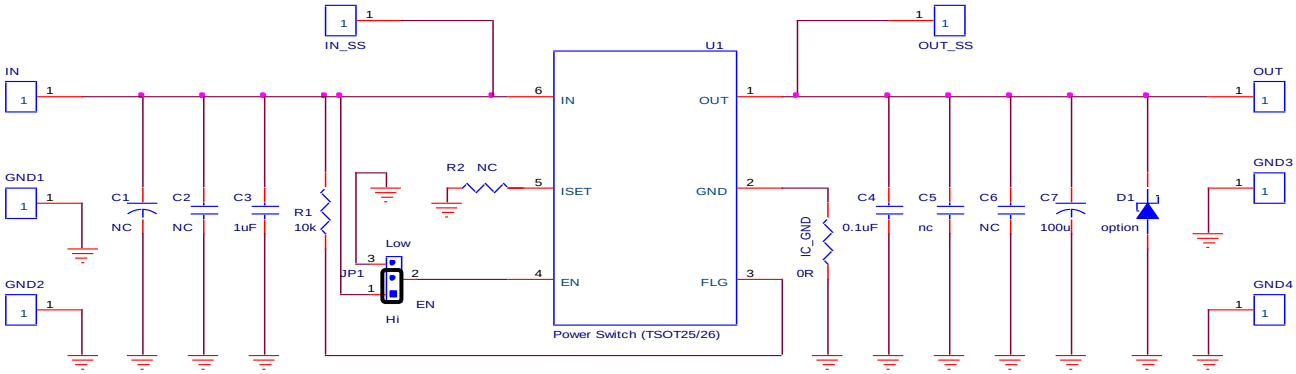


For AP22615BWU

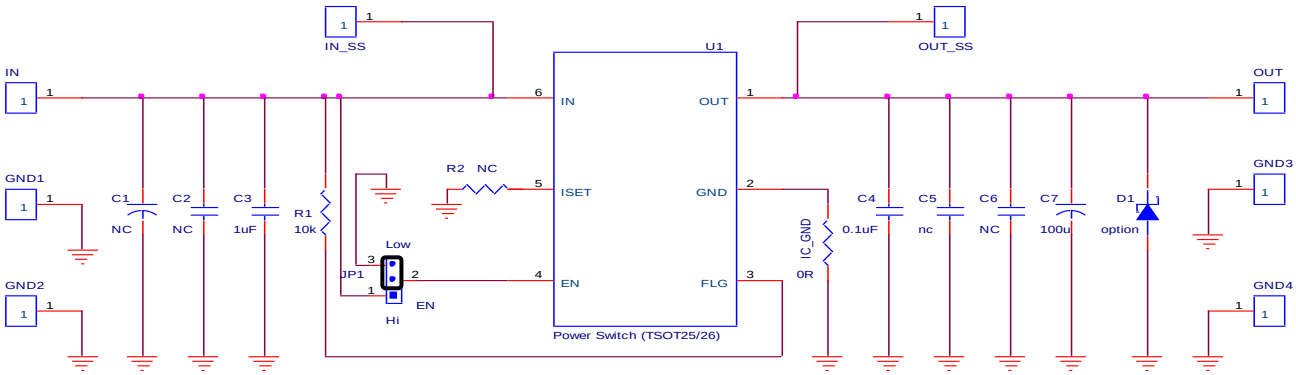


Evaluation Board Schematic

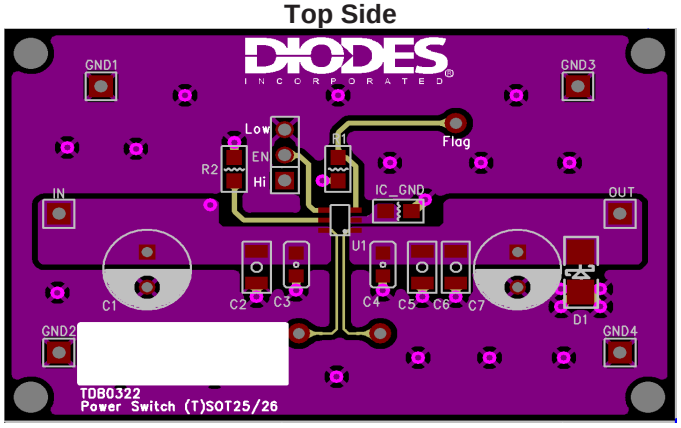
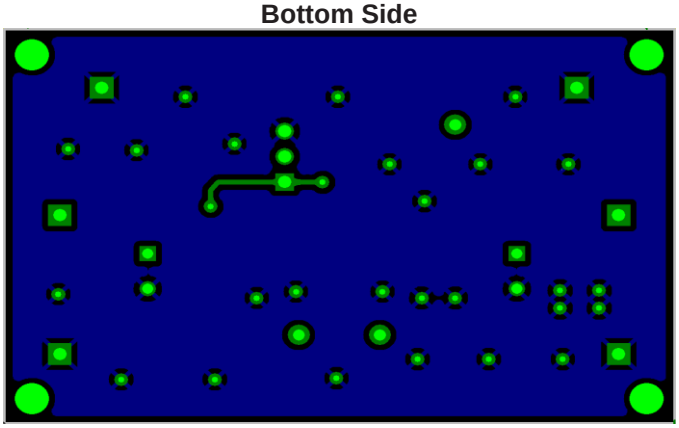
For AP22815AWT



For AP22815BWT



PCB Layout

Top Side	Bottom Side
	
(T)SOT25/26	(T)SOT25/26

Bill of Materials

For AP22615AWU

Component Location	Qty	Specification	Mark	Maker Part No.	Size
C3	1	Cap MLCC 1μF/25V/X7R	TAIYO YUDEN	TMK107B7105KA-T	C0603
C4	1	Cap MLCC 0.1μF/100V/X7R	TAIYO YUDEN	HMK107C7104KA-T	C0603
C7	1	Aluminum Capacitor, 100μF /35V/UHV/105°C	NICHICON	493-13394-ND	6.3X12.5
R1	1	10kΩ(1%)	YAGEO	RC0603FR-SK	R0603
R2	1	6.8kΩ(1%)	YAGEO	RC0603FR-SK	R0603
IN, GND2, OUT, GND4	4	Test pin	-	TEST-8	2.2mmX 13.5mm
IC_GND, EN&Hi	2	Short	-	-	-
C2, C5, C6, D1, GND1, GND3	0	NC	-	-	-
U1	1	AP22615, 3A, Single Channel Power Distribution Switch With Output OVP, Active High	Diodes Inc.	AP22615AWU	TSOT26
PCB	1	Power Switch (T)SOT25/26	Diodes Inc.	TDB0322	61mmX39mm

For AP22615BWU

Component Location	Qty	Specification	Mark	Maker Part No.	Size
C3	1	Cap MLCC 1μF/25V/X7R	TAIYO YUDEN	TMK107B7105KA-T	C0603
C4	1	Cap MLCC 0.1μF/100V/X7R	TAIYO YUDEN	HMK107C7104KA-T	C0603
C7	1	Aluminum Capacitor, 100μF /35V/UHV/105°C	NICHICON	493-13394-ND	6.3X12.5
R1	1	10kΩ(1%)	YAGEO	RC0603FR-SK	R0603
R2	1	6.8kΩ(1%)	YAGEO	RC0603FR-SK	R0603
IN, GND2, OUT, GND4	4	Test pin	-	TEST-8	2.2mmX 13.5mm
IC_GND, EN&Low	2	Short	-	-	-
C2, C5, C6, D1, GND1, GND3	0	NC	-	-	-
U1	1	AP22615, 3A, Single Channel Power Distribution Switch With Output OVP, Active Low	Diodes Inc.	AP22615BWU	TSOT26
PCB	1	Power Switch (T)SOT25/26	Diodes Inc.	TDB0322	61mmX39mm

Bill of Materials

For AP22815AWT

Component Location	Qty	Specification	Mark	Maker Part No.	Size
C3	1	Cap MLCC 1μF/25V/X7R	TAIYO YUDEN	TMK107B7105KA-T	C0603
C4	1	Cap MLCC 0.1μF/100V/X7R	TAIYO YUDEN	HMK107C7104KA-T	C0603
C7	1	Aluminum Capacitor, 100μF /35V/UHV/105°C	NICHICON	493-13394-ND	6.3X12.5
R1	1	10kΩ(1%)	YAGEO	RC0603FR-SK	R0603
IN, GND2, OUT, GND4	4	Test pin	-	TEST-8	2.2mmX 13.5mm
IC_GND, EN&Hi	2	Short	-	-	-
C2, C5, C6, D1, GND1, GND3, R2	0	NC	-	-	-
U1	1	AP22815, 3A, Single Channel Power Distribution Switch With Output OVP, Active High	Diodes Inc.	AP22815AWT	TSOT25
PCB	1	Power Switch (T)SOT25/26	Diodes Inc.	TDB0322	61mmX39mm

For AP22815BWT

Component Location	Qty	Specification	Mark	Maker Part No.	Size
C3	1	Cap MLCC 1μF/25V/X7R	TAIYO YUDEN	TMK107B7105KA-T	C0603
C4	1	Cap MLCC 0.1μF/100V/X7R	TAIYO YUDEN	HMK107C7104KA-T	C0603
C7	1	Aluminum Capacitor, 100μF /35V/UHV/105°C	NICHICON	493-13394-ND	6.3X12.5
R1	1	10kΩ(1%)	YAGEO	RC0603FR-SK	R0603
IN, GND2, OUT, GND4	4	Test pin	-	TEST-8	2.2mmX 13.5mm
IC_GND, EN&Low	2	Short	-	-	-
C2, C5, C6, D1, GND1, GND3, R2	0	NC	-	-	-
U1	1	AP22815, 3A, Single Channel Power Distribution Switch With Output OVP, Active Low	Diodes Inc.	AP22815BWT	TSOT25
PCB	1	Power Switch (T)SOT25/26	Diodes Inc.	TDB0322	61mmX39mm

Vendors of peripheral components

Suggested Capacitors：

Vendor	Capacitance	Type	Series
TAIYO YUDEN	Cap MLCC 1μF/50V/X5R	SMD	UMK212ABJ105KD-T
TAIYO YUDEN	Cap MLCC 1μF/25V/X7R	SMD	TMK107B7105KA-T
MURATA	Cap MLCC 1μF/16V/X7R	SMD	GRM188R71C105
TAIYO YUDEN	Cap MLCC 0.1μF/100V/X5R	SMD	HMK107BJ104KA-T
TAIYO YUDEN	Cap MLCC 0.1uF/50V/X7R	SMD	UMK212B7104KG-T
NICHICON	Aluminum Capacitors, 100μF /35V/UHV/105°C	DIP	UHV1V101MED

Suggested Resistor：

Vendor	Type	Series
YAGEO	SMD	RC0603FR-SK

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