



**ALGOLTEK**

**AG9311**

**USB Type-C to HDMI with  
Power Delivery 3.0  
Converter**

Data Sheet

Official Version

V1.6

July, 2018



## Revision History

Version	Date	Notes
0.1	2018/7/30	Preliminary release
0.2	2018/8/27	Added AG9311-MCQ Package Type
0.3	2018/10/01	Remove MBQ Package Type
1.0	2018/11/1	Official Release
1.1	2018/12/27	Modified I2C description Added GPIO_6/CEC description
1.2	2019/4/29	Update Table4: Add $T_j$ / $\theta_{JC}$ / $\theta_{JA}$
1.3	2019/8/21	Update Features description
1.4	2019/9/2	Redefine Pin naming
1.5	2019/9/25	Modified E-PAD SIZE of AG9311-MAQ
1.6	2019/10/03	Modified 1.2V Typ. Value to 1.23V

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**Index**

**I. General Description..... 5**

**II. Features ..... 5**

**III. Device Information..... 6**

**IV. Application..... 6**

**V. System Block Diagram ..... 7**

**VI. Pin Mapping and Description ..... 8**

**VII. Specification .....15**

**i. Absolute Maximum Rating .....15**

**ii. DC Characteristics/Operating Conditions .....15**

**iii. AC Characteristics .....16**

**VIII. Packing and Marking Specification .....19**

**IX. References .....22**

**X. Contact Information .....22**

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## List of Figure

Figure 1 Application for Type-C to HDMI Dongle .....	6
Figure 2 System Block Diagram .....	7
Figure 3 AG9311-MAQ Pin Mapping .....	8
Figure 4 AG9311-MCQ Pin Mapping .....	12
Figure 5 AG9311-MAQ Package Dimension .....	20
Figure 6 AG9311-MCQ Package Dimension .....	21

## List of Table

Table 1 PIN Description .....	9
Table 2 PIN Description .....	12
Table 3 Absolute Maximum Rating .....	15
Table 4 Digital I/O Specification .....	16
Table 5 DisplayPort Input Timing .....	16
Table 6 DisplayPort AUX Channel I/O Specification .....	17
Table 7 USB I/O Specification .....	18
Table 8 USB PD Specification .....	18



## I. General Description

ALGOLTEK AG9311 is highly integration solution transmit video and audio stream from DP alternate mode over USB Type-C to HDMI output. The AG9311 provides DisplayPort 1.2 receiver over various @1.62Gbps, 2.7Gbps and 5.4Gbps up to 2 lanes; and supports HDMI frequencies up to 297MHz, which enables 4K x 2K@30Hz. User easily integrate AG9311 on any USB Type-C video conversion on dongles and docking stations application.

## II. Features

- DisplayPort
  - Compliant to DisplayPort specification Revision 1.2
  - Support 1.62(RBR)/2.7(HBR)/5.4(HBR2) Gbps data rate
  - Support 1/2 Lane configurations
  - Down Spread Spectrum Clock (SSC) supported
  - Support Audio Extraction over I2S bus
- HDMI
  - Compliant to HDMI1.4 and HDCP1.4 specifications
  - Support TMDS up to 3Gbps
  - Support resolution up to 4K x 2K @30Hz output
  - Pre-programmed with HDCP key
  - Transparent EDID and MCCS
  - Support LPCM 2-Channel of sample rate 48kHz/44.1KHz/32KHz
- USB Type-C and Power Delivery
  - Support DisplayPort Alternate mode protocol
  - Compliant to USB Power Delivery specification Revision 3.0
  - Integrated complete termination of the Type-C R<sub>P</sub> and R<sub>D</sub> resistors
  - Supports two USB Type-C port
  - Support USB Billboard function
  - Integrated USB2.0 Full-speed PHY
- MCU System and Interface
  - Embedded 16 bit MCU on-chip
  - Embedded 64KB flash for firmware upgrade
  - Support I2C Master/Slave, UART and USB2.0 Full-speed
  - Support 3-Channel ADC-8bit resolutions

- Power Operation and ESD
  - 3.3V: 3V to 3.6V operation
  - 1.2V: 1.08 to 1.32V operation
  - 1.2V Core power and 3.3V I/O power
  - HBM 2KV ESD performance

### III. Device Information

Part Number	Package	Body Size	Note
AG9311-MAQ	QFN-64	8x8 mm <sup>2</sup>	/w I <sup>2</sup> S audio output
AG9311-MCQ	QFN-48	6x6 mm <sup>2</sup>	/wo I <sup>2</sup> S audio output

### IV. Application

- USB Type-C dongle
- USB Type-C docking station

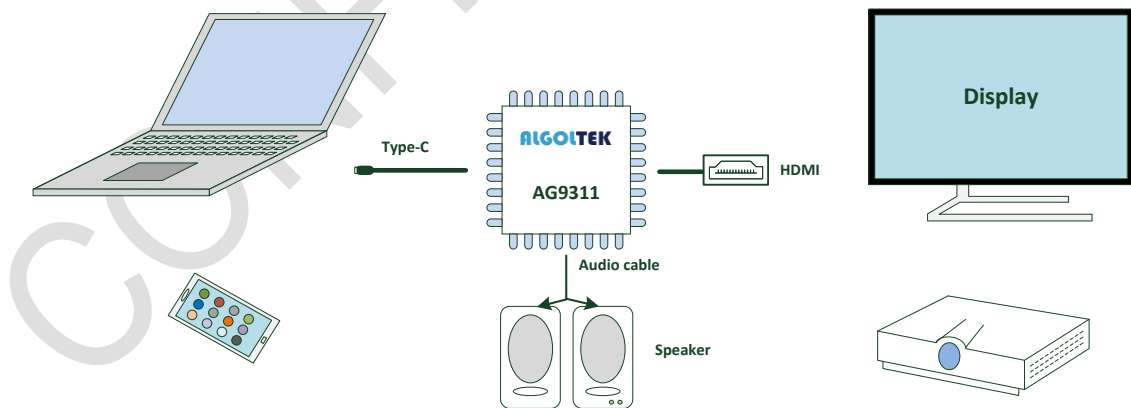


Figure 1 Application for Type-C to HDMI Dongle

## V. System Block Diagram

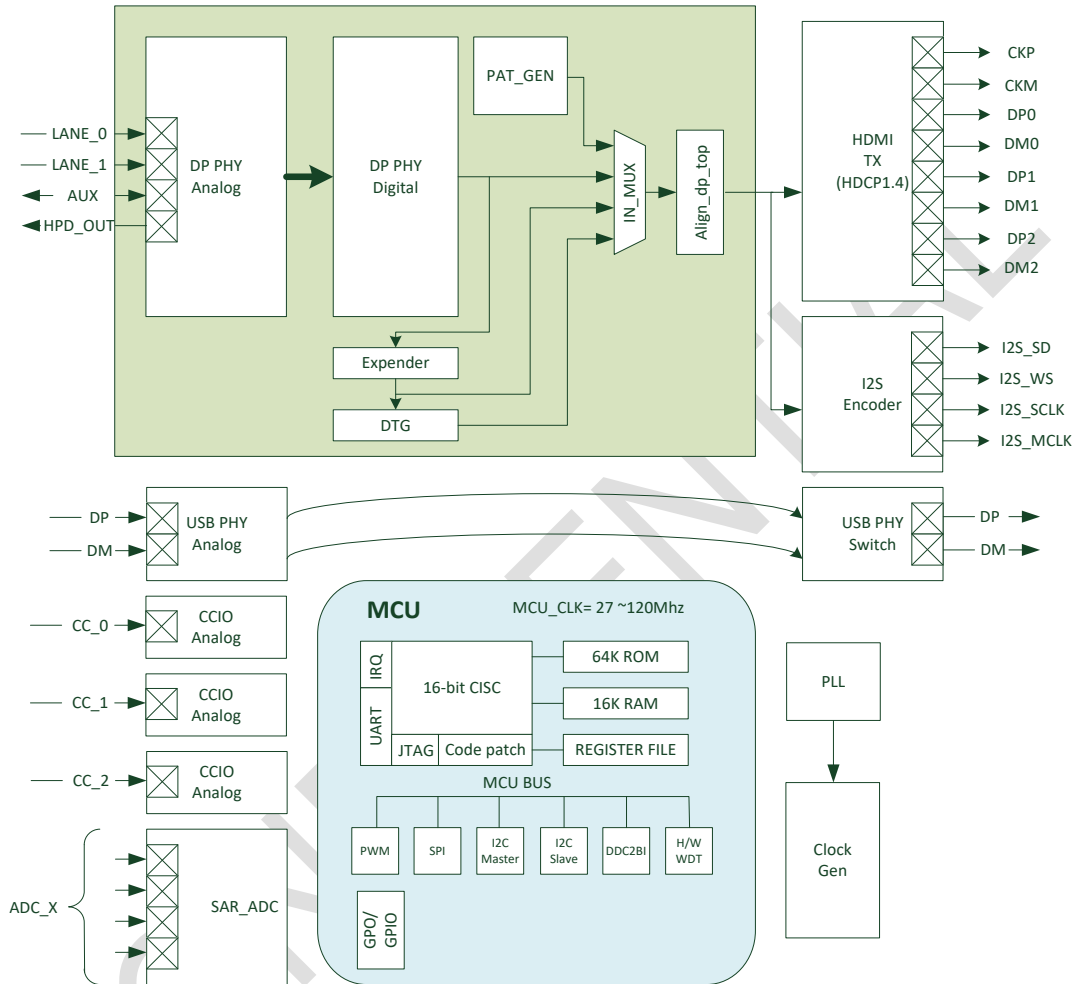


Figure 2 System Block Diagram

## VI. Pin Mapping and Description

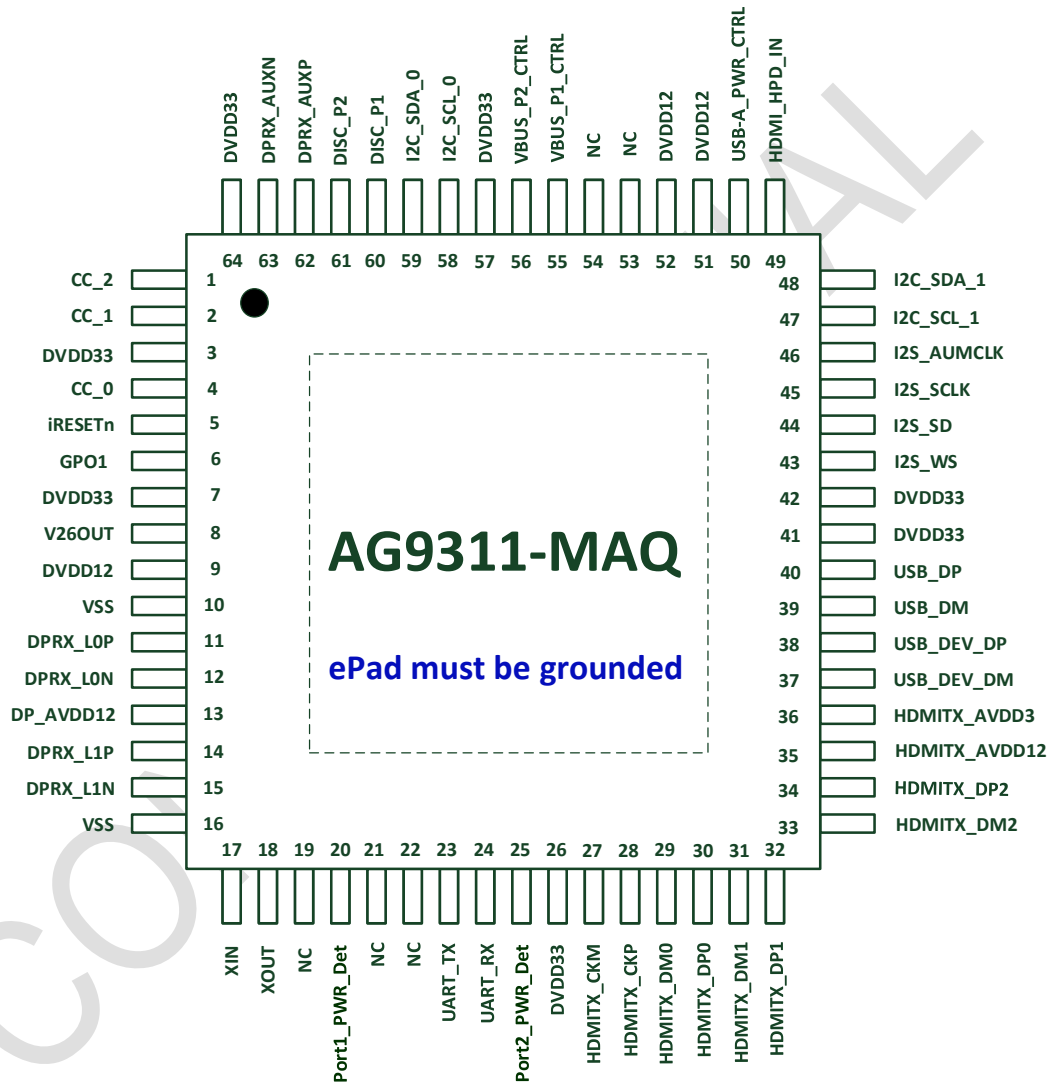


Figure 3 AG9311-MAQ Pin Mapping





Table 1 PIN Description

PIN NO.	Pin Name	Type	Description
1	CC_2	Bidirectional	USB Type-C configuration channel_2. The channel is used for AC charger attach/detach by default
2	CC_1	Bidirectional	USB Type-C configuration channel_1. The channel is used for DP alternate mode devices attach/detach by default.
3	DVDD33	Power	Digital 3.3V power
4	CC_0	Bidirectional	USB Type-C configuration channel_0. The channel is used for AC charger attach/detach by default.
5	iRESETN	Input	Reset, active low
6	GPO_1	Output	General purpose output port 1.
7	DVDD33	Power	Digital 3.3V power
8	V26OUT	Power	Internal analog 2.6v power decouple
9	DVDD12	Power	Digital 1.2V power
10	VSS	Power	Digital ground
11	DPRX_L0P	Input	DP RX lane0 positive
12	DPRX_L0N	Input	DP RX lane0 negative
13	DP_AVDD12	Power	Analog 1.2V power for DP RX
14	DPRX_L1P	Input	DP RX lane1 positive
15	DPRX_L1N	Input	DP RX lane1 negative
16	VSS	Power	Digital ground
17	XIN	Input	Crystal oscillator clock input
18	XOUT	Output	Crystal oscillator clock output
19	NC	NC	NC
20	Port1_PWR_Det	Input	Port1 USB Type-C VBUS voltage detection. The port used to connect with DP alternate mode devices by default.
21	NC	NC	NC
22	NC	NC	NC
23	UART_TX	Output	UART TX
24	UART_RX	Input	UART RX
25	Port2_PWR_Det	Input	Port2 USB Type-C VBUS voltage detection. The port used to connect with AC charger by default.



PIN NO.	Pin Name	Type	Description
26	DVDD33	Power	Digital 3.3V power
27	HDMITX_CKM	Output	HDMI TX clock channel negative
28	HDMITX_CKP	Output	HDMI TX clock channel positive
29	HDMITX_DM0	Output	HDMI TX data channel 0 negative
30	HDMITX_DP0	Output	HDMI TX data channel 0 positive
31	HDMITX_DM1	Output	HDMI TX data channel 1 negative
32	HDMITX_DP1	Output	HDMI TX data channel 1 positive
33	HDMITX_DM2	Output	HDMI TX data channel 2 negative
34	HDMITX_DP2	Output	HDMI TX data channel 2 positive
35	HDMITX_AVDD12	Power	Analog 1.2V power for HDMI TX
36	HDMITX_AVDD3	Power	Analog 3.3V power for HDMI TX
37	USB_DEV_DM	Bidirectional	USB negative Data Line
38	USB_DEV_DP	Bidirectional	USB positive Data Line
39	USB_DM	Bidirectional	USB Billboard negative Data Line
40	USB_DP	Bidirectional	USB Billboard positive Data Line
41	DVDD33	Power	Digital 3.3V power
42	DVDD33	Power	Digital 3.3V power
43	I2S_WS	Output	I2S Left Right Clock
44	I2S_SD	Output	I2S Serial Audio Data Output
45	I2S_SCLK	Output	I2S Continuous Serial Clock
46	I2S_AUMCLK	Output	I2S System Clock
47	I2C_SCL_1	Bidirectional	Master/Slave I2C SCL
48	I2C_SDA_1	Bidirectional	Master/Slave I2C SDA
49	HDMI_HPD_IN	Input	HDMI cable detection
50	USB-A_PWR_CTRL	Output	Control USB-A port power current-limited switch.
51	DVDD12	Power	Digital 1.2V power
52	DVDD12	Power	Digital 1.2V power
53	NC	NC	NC
54	NC	NC	NC
55	VBUS_P1_CTRL	Output	Control port1 power switch base on PD contract complete



PIN NO.	Pin Name	Type	Description
			The port used to connect with DP alternate mode devices by default.
56	VBUS_P2_CTRL	Output	Control port2 power switch base on PD contract complete The port used to connect with AC charger by default
57	DVDD33	Power	Digital 3.3V power
58	I2C_SCL_0	Bidirectional	HDMI I2C SCL
59	I2C_SDA_0	Bidirectional	HDMI I2C SDA
60	DISC_P1	Output	Control Port1 VBUS discharge when the port is disconnected. The port used to connect with DP alternate mode devices by default.
61	DISC_P2	Output	Control Port2 VBUS discharge when the port is disconnected. The port used to connect with AC charger by default.
62	DPRX_AUXP	Bidirectional	DisplayPort AUX channel P
63	DPRX_AUXN	Bidirectional	DisplayPort AUX channel N
64	DVDD33	Power	Digital 3.3V power

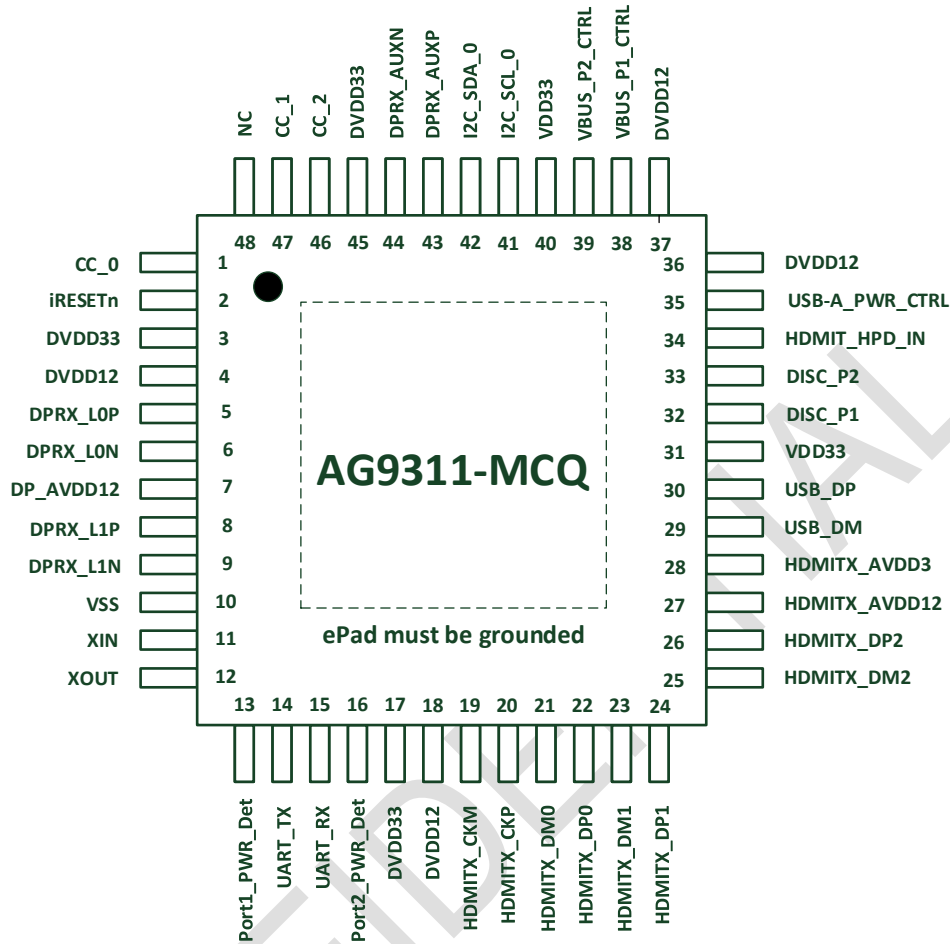


Figure 4 AG9311-MCQ Pin Mapping

Table 2 PIN Description

PIN NO.	Pin Name	Type	Description
1	CC_0	Bidirectional	USB Type-C configuration channel_0. The channel is used for AC charger attach/detach by default.
2	iRESETN	Input	Reset, active low
3	DVDD33	Power	Digital 3.3V power
4	DVDD12	Power	Digital 1.2V power
5	DPRX_L0P	Input	DP RX lane0 positive
6	DPRX_L0N	Input	DP RX lane0 negative
7	DP_AVDD12	Power	Analog 1.2V power for DP RX
8	DPRX_L1P	Input	DP RX lane1 positive
9	DPRX_L1N	Input	DP RX lane1 negative
10	VSS	Power	Digital ground



PIN NO.	Pin Name	Type	Description
11	XIN	Input	Crystal oscillator clock input
12	XOUT	Output	Crystal oscillator clock output
13	Port1_PWR_Det	Input	Port1 USB Type-C VBUS voltage detection. The port used to connect with DP alternate mode devices by default
14	UART_TX	Output	UART TX
15	UART_RX	Input	UART RX
16	Port2_PWR_Det	Input	Port2 USB Type-C VBUS voltage detection. The port used to connect with AC charger by default
17	DVDD33	Power	Digital 3.3V power
18	DVDD12	Power	Digital 1.2V power
19	HDMITX_CKM	Output	HDMI TX clock channel negative
20	HDMITX_CKP	Output	HDMI TX clock channel positive
21	HDMITX_DM0	Output	HDMI TX data channel 0 negative
22	HDMITX_DP0	Output	HDMI TX data channel 0 positive
23	HDMITX_DM1	Output	HDMI TX data channel 1 negative
24	HDMITX_DP1	Output	HDMI TX data channel 1 positive
25	HDMITX_DM2	Output	HDMI TX data channel 2 negative
26	HDMITX_DP2	Output	HDMI TX data channel 2 positive
27	HDMITX_AVDD12	Power	Analog 1.2V power for HDMI TX
28	HDMITX_AVDD3	Power	Analog 3.3V power for HDMI TX
29	USB_DM	Bidirectional	USB Billboard negative Data Line
30	USB_DP	Bidirectional	USB Billboard positive Data Line
31	DVDD33	Power	Digital 3.3V power
32	DISC_P1	Output	Control Port1 VBUS discharge when the port is disconnected. The port used to connect with DP alternate mode devices by default.
33	DISC_P2	Output	Control Port2 VBUS discharge when the port is disconnected. The port used to connect with AC charger by default.
34	HDMI_HPD_IN	Input	HDMI cable detection
35	USB-	Output	Control USB-A port power current-limited switch.



PIN NO.	Pin Name	Type	Description
	A_PWR_CTRL		
36	DVDD12	Power	Digital 1.2V power
37	DVDD12	Power	Digital 1.2V power
38	VBUS_P1_CTRL	Output	Control port1 power switch base on PD contract complete The port used to connect with DP alternate mode devices by default.
39	VBUS_P2_CTRL	Output	Control port2 power switch base on PD contract complete The port used to connect with AC charger by default
40	DVDD33	Power	Digital 3.3V power
41	I2C_SCL_0	Bidirectional	HDMI I2C SCL
42	I2C_SDA_0	Bidirectional	HDMI I2C SDA
43	DPRX_AUXP	Bidirectional	DisplayPort AUX channel P
44	DPRX_AUXN	Bidirectional	DisplayPort AUX channel N
45	DVDD33	Power	Digital 3.3V power
46	CC_2	Bidirectional	USB Type-C configuration channel_2. The channel is used for AC charger attach/detach by default.
47	CC_1	Bidirectional	USB Type-C configuration channel_1. The channel is used for DP alternate mode devices attach/detach by default.
48	NC	NC	NC



## VII. Specification

### i. Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
VDD33/AVDD33	3.3V supply voltage	-0.5	3.63	V
VDD/AVDD	1.2V supply voltage	-0.5	1.32	V

Table 3 Absolute Maximum Rating

### ii. DC Characteristics/Operating Conditions

Symbol	Parameter	Min	Typ.	Max	Unit
VDD33	Digital I/O supply voltage	3	3.3	3.6	V
VDD	Digital core supply voltage	1.16	1.23		V
AVDD3	Analog I/O supply voltage	3	3.3	3.6	V
AVDD	Analog core supply voltage	1.16	1.23		V
$I_{VDD33+AVDD3}$	3.3V I/O Supply Current(4K2K/30Hz)			70(/Wol2S) 85(/Wl2S)	mA
$I_{VDD+AVDD}$	1.2V Core supply Current(4K2K/30Hz)			268	mA
$V_{OH}$	Output High Voltage	2.4			V
$V_{OL}$	Output Low Voltage			0.4	V
$V_{IH}$	Input High Voltage	2.0		5.5	V
$V_{IL}$	Input Low Voltage	-0.3		0.8	V
$I_{LI}$	Input leakage Cur.			±1	uA
$\theta_{JC}$	Thermal Resistance of QFN48L (Junction to Case)		2.0		°C/W
	Thermal Resistance of QFN64L (Junction to Case)		1.2		°C/W
$\theta_{JA}$	Thermal Resistance of QFN48L (Junction to Ambient)		33		°C/W
	Thermal Resistance of QFN64L (Junction to Ambient)		24		°C/W



T <sub>J</sub>	Junction Temperature	0		125	°C
T <sub>A</sub>	Ambient Temperature	0		70	°C

Table 4 Digital I/O Specification

### iii. AC Characteristics

#### DisplayPort Main Link AC Characteristics

Symbol	Parameter	Min	Typ.	Max	Unit
UI_HBR2	Unit interval for HBR2(5.4-Gbps/lane)		185		ps
UI_HBR	Unit interval for HBR(2.7-Gbps/lane)		370		ps
UI_RBR	Unit interval for RBR(1.62-Gbps/lane)		617		ps
Down_Spread_Amp.	Link clock down-spreading	0		0.5	%
Down_Spread_Frequency	Link clock down-spreading frequency	30		33	kHz
T <sub>RX-MEDIAN-to-MAX-JITTER</sub>	Max time between the jitter median and max. deviation from the median at Rx package pins for HBR (2.7-Gbps)			0.265	UI
T <sub>RX-MEDIAN-to-MAX-JITTER</sub>	Max. time between the jitter median and max. deviation from the median at Rx package pins for RBR (1.62-Gbps)			0.39	UI
V <sub>RX-DC-CM</sub>	RX DC Common Mode Voltage	0		2	V
I <sub>RX-SHORT</sub>	RX Short Circuit Current Limit			50	mA

Table 5 DisplayPort Input Timing





### DisplayPort AUX-CH AC Characteristics

Symbol	Parameter	Min	Typ.	Max	Unit
UIMAN	AUX (Manchester transaction) unit interval	0.4	0.5	0.6	us
Pre-charge Pulses	Number of pre-charge pulses	10		16	
$T_{AUX-BUS-PEAK}$	AUX CH bus park time	10			ns
$T_{\text{cycle-to-cycle jitter}}$	Maximum allowable variation for adjacent bit times within a single transaction at connector pins of a receiving device			0.05	UI
$V_{AUX-DIFFp-p RX}$	AUX peak-to-peak voltage at a transmitting device when receiving	0.29		1.38	V
$V_{AUX-DIFFp-p RX}$	AUX peak-to-peak voltage at a receiving device when receiving	0.27		1.36	V
$V_{AUX\_TERM\_R}$	AUX CH termination DC resistance		100		$\Omega$
$V_{AUX\_DC\_CM}$	AUX DC common mode voltage	0		2.0	V
$V_{AUX\_TURN\_CM}$	AUX turn around common mode voltage			0.3	V
$I_{AUX\_SHORT}$	AUX short circuit current			90	mA
$C_{AUX}$	AUX AC coupling	75		200	nF

Table 6 DisplayPort AUX Channel I/O Specification



### USB PD BMC Receiver Normative Requirements

Name	Description	Min	Typ.	Max	Unit
cReceiver	CC receiver capacitance	200		600	pF
nTransitionCount	Transitions for signal detect	3			
tRxFilter	Rx bandwidth limiting filter (digital or analog)	100			ns
tTransitionWindow	Time window for detecting non-idle	12		20	Us
zBmcRx	Receiver Input Impedance	1			MΩ
vNoiseActive	Noise amplitude when BMC is active.			165	mV
vNoiseIdle	Noise amplitude when BMC is idle.			300	mV
vIRDropGNDC	Cable Ground IR Drop			250	mV

Table 7 USB I/O Specification

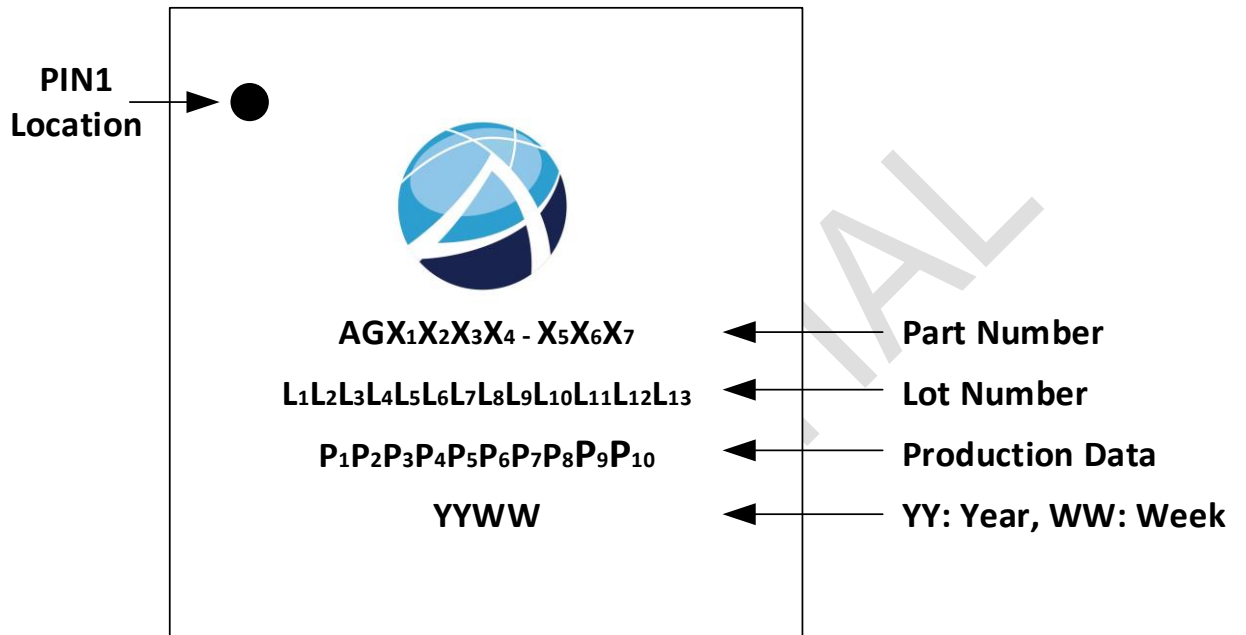
### USB PD BMC Transmitter Normative Requirements

Name	Description	Min	Typ.	Max	Unit
tEndDriveBMC	Time to cease driving the line after the end of the last bit of the Frame.			23	us
tFall	Fall Time	300			ns
tHoldLowBMC	Time to cease driving the line after the final high-to-low transition.	1			us
tRise	Rise time	300			ns
vSwing	Voltage Swing	1.05	1.125	1.2	V
zDriver	Transmitter output impedance	33		75	Ω

Table 8 USB PD Specification

## VIII. Packing and Marking Specification

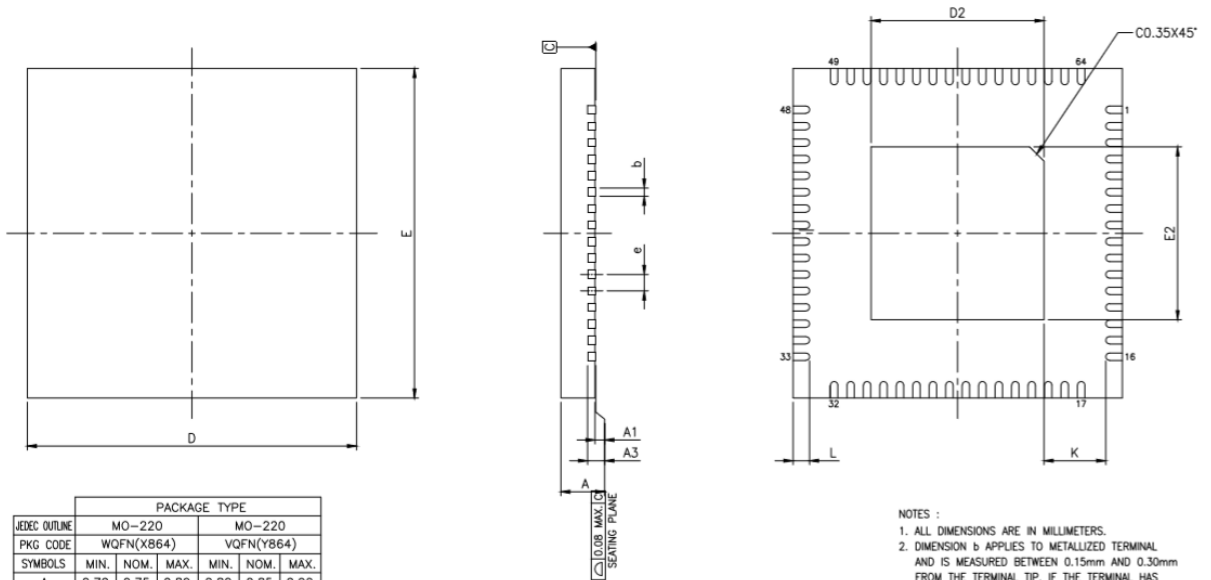
- Marking





● Package Dimension

AG9311-MAQ: QFN-64L 8x8mm(E-PAD SIZE:181x18\*MIL)



- NOTES :
1. ALL DIMENSIONS ARE IN MILLIMETERS.
  2. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
  3. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

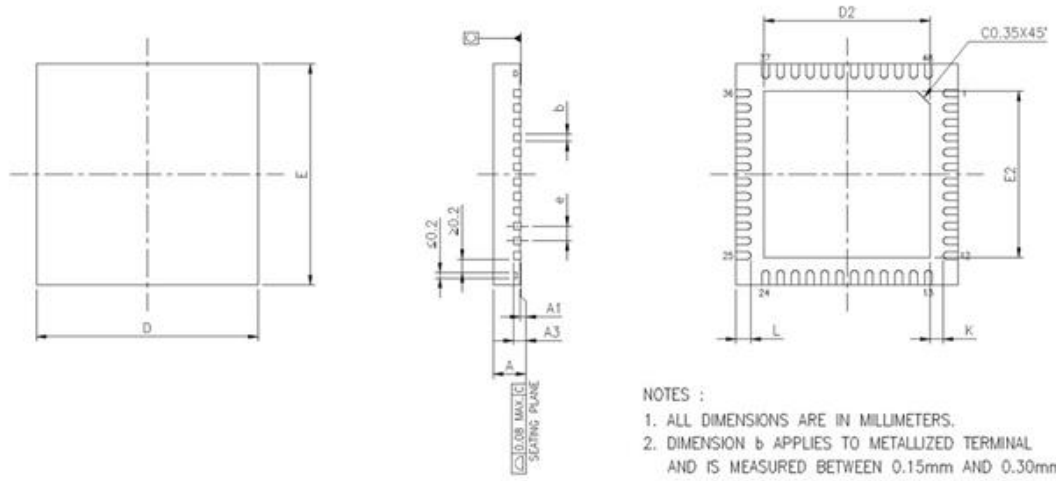
JEDEC OUTLINE	PACKAGE TYPE					
	MO-220			MO-220		
	WQFN(X864)			VQFN(Y864)		
SYMBOLS	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.80	0.85	0.90
A1	0.00	0.02	0.05	0.00	0.02	0.05
A3	0.203 REF.			0.203 REF.		
b	0.15	0.20	0.25	0.15	0.20	0.25
D	8.00 BSC			8.00 BSC		
E	8.00 BSC			8.00 BSC		
e	0.40 BSC			0.40 BSC		
L	0.35	0.40	0.45	0.35	0.40	0.45
K	0.20	—	—	0.20	—	—

PAD SIZE	D2			E2			LEAD FINISH		JEDEC CODE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	Pure Tin	PPF	
181X18* MIL	4.15	4.20	4.25	4.15	4.20	4.25	V	X	N/A
268X26* MIL	6.40	6.50	6.60	6.40	6.50	6.60	V	X	W(V)LLE-2

\*\*\*表示汎用字元,此汎用字元可能被其它不同字元所取代,實際的字元請參照bonding diagram所示。  
 \*\*\* is an universal character, which means maybe replaced by specific character, the actual character please refers to the bonding diagram.

Figure 5 AG9311-MAQ Package Dimension

**AG9311-MCQ: QFN-48L 6x6mm(E-PAD SIZE:185x18\*MIL)**



A1	0.00	0.02	0.05
A3	0.203 REF.		
b	0.15	0.20	0.25
D	6.00 BSC		
E	6.00 BSC		
e	0.40 BSC		
K	0.20	—	—

- NOTES :
1. ALL DIMENSIONS ARE IN MILLIMETERS.
  2. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
  3. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

PAD SIZE	D2			E2			L			LEAD FINISH		JEDEC CODE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	Pure Sn	PPF	
185x18* ML	4.45	4.50	4.55	4.45	4.50	4.55	0.35	0.40	0.45	v	x	(W)VJE-1

**Figure 6 AG9311-MCQ Package Dimension**

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## IX. References

- DisplayPort™ Standard 1.2b Specification
- HDMI 1.4b Specification

## X. Contact Information

ALGOLTEK, INC.

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