

HDMI Switch ICs

1 for input 1 output buffer with Termination sense correspondence (Sync with HPD_SINK)

BU16024KV

**●Description**

BU16024KV is 1 for input 1 output HDMI/DVI buffer LSI. Each port supports 2.25Gbps. (HDMI 1.3a).

This device control is simple. It requires only 3.3V and a few GPIO controls.

Terminated resistors(50Ω) are integrated at each input port. When HPD_SINK is L, termination resistors are turned off.

TMDs inputs are high impedance.

This device is integrated equalization function and DDC buffer function, so It can adapt long cable.

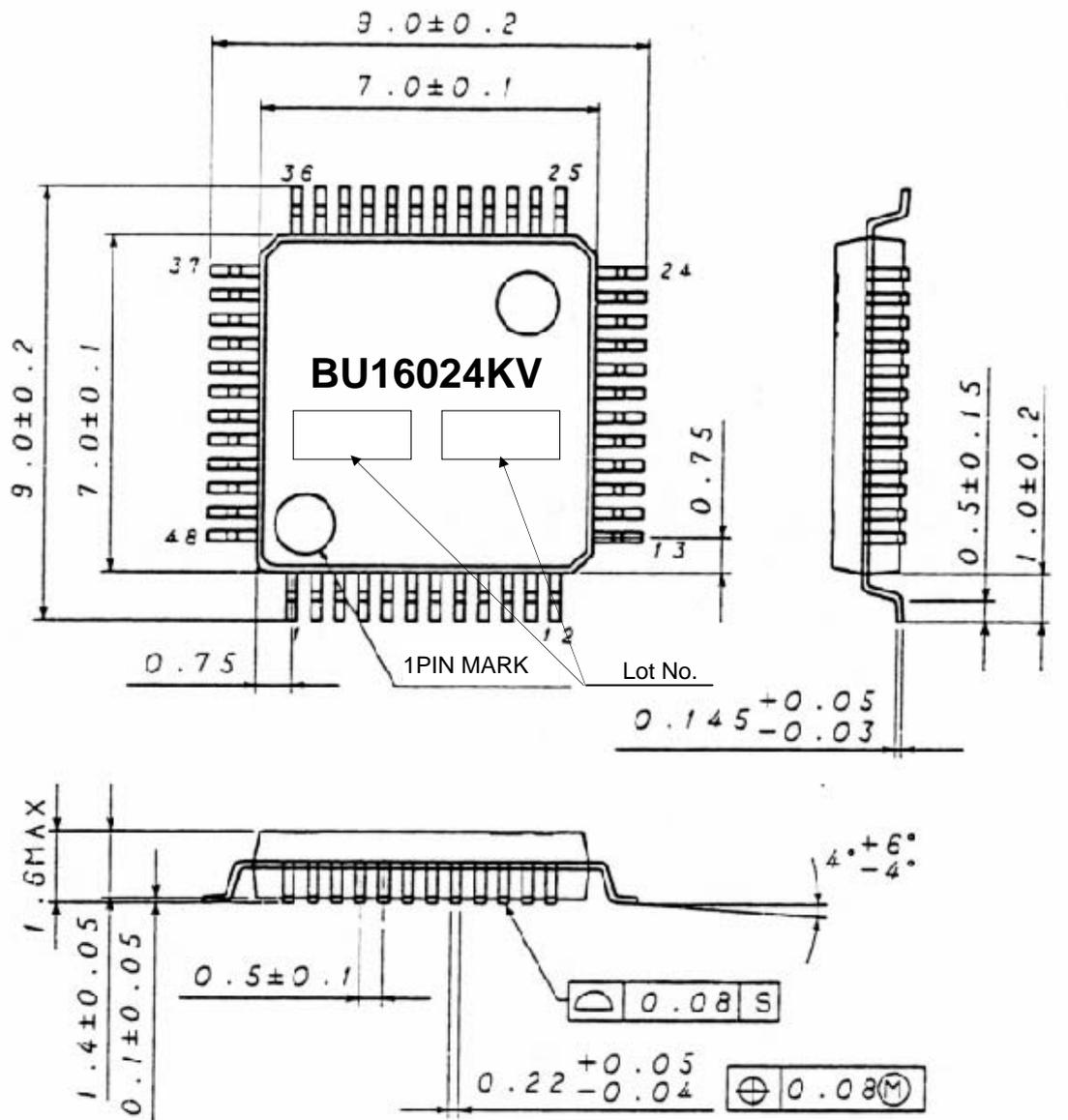
●Features

- Supports 2.25 Gbps signaling rate for 480i/p, 720i/p, and 1080i/p resolution to 12-bit color depth
- Compatible with HDMI 1.3a
- 5V tolerance to all DDC and HPD_SINK inputs
- Integrated DDC buffer
- Integrated switchable 50Ω receiver termination
- Integrated equalizer circuit to adapt long cable
- Selectable output De-Emphasis Supports
- High Impedance outputs when disabled
- HBM ESD protection exceed 10kV
- 3.3-V supply operation
- 48-Pin VQFP package
- ROHS compatible

●Applications

- Digital TV
- DVD Player
- Set-Top-Box
- Audio Video Receiver
- Digital Projector
- DVI or HDMI Switch Box
- PC

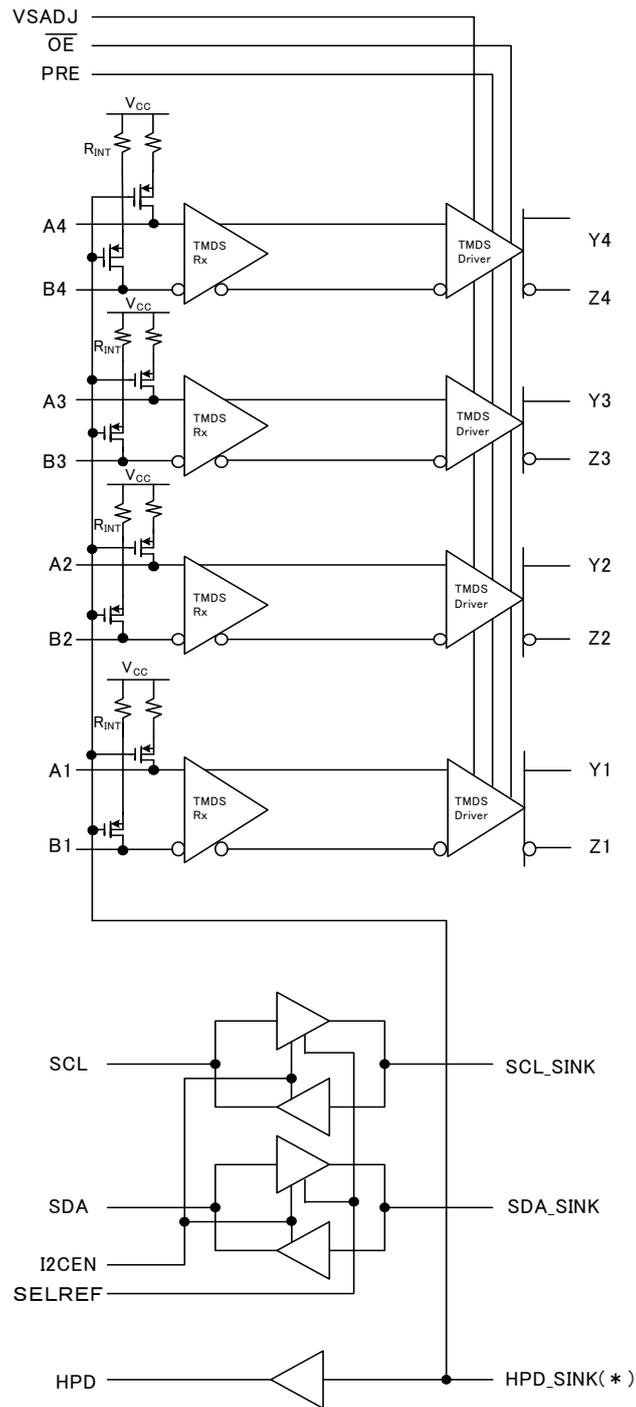
●OUTSIDE DIMENSION CHART



(UNIT : mm)

Fig. 1-1 . Outside dimension chart

●BLOCK DIAGRAM



(*) when HPD_SINK = "L". Termination resistor is turned off.

Fig. 2-1. Block Diagram

● PIN EXPLANATION

1). PIN ASSIGNMENT

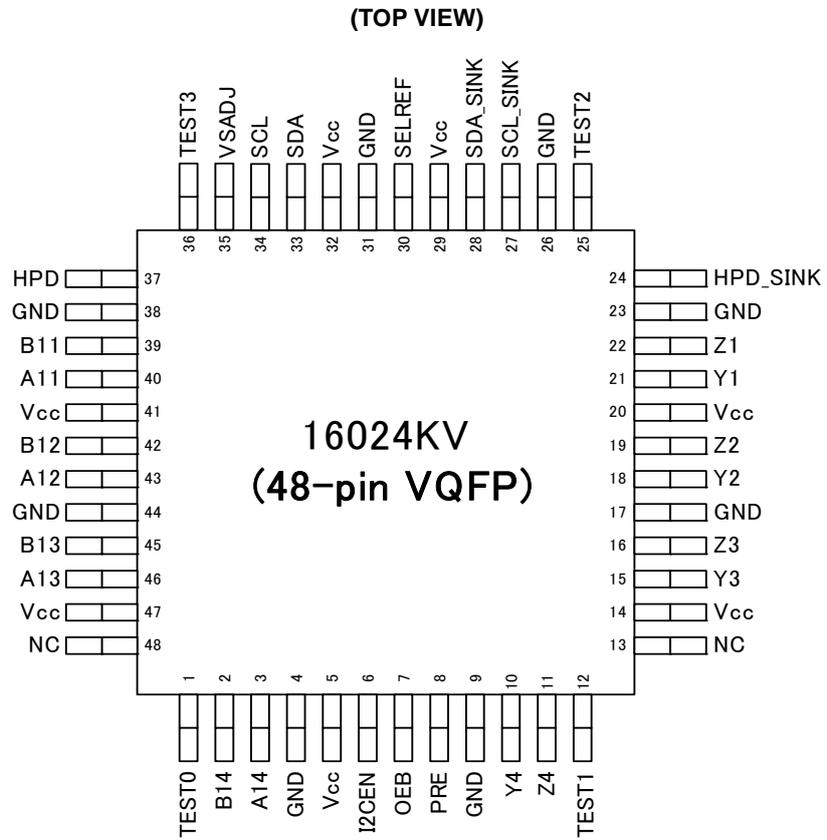


Fig3-1. Pin Location

2). PIN LIST

TERMINAL		I/O	DESCRIPTION
NAME	No.		
B1, B2, B3, B4	39, 42, 45, 2	I	TMDS Negative inputs
A1, A2, A3, A4	40, 43, 46, 3	I	TMDS Positive inputs
Z1, Z2, Z3, Z4	22, 19, 16, 11	O	TMDS Negative outputs
Y1, Y2, Y3, Y4	21, 18, 15, 10	O	TMDS Positive outputs
HPD	37	O	Hot plug detector output
HPD_SINK	24	I	Hot plug detector input
SCL	34	I/O	DDC Bus clock line to source
SDA	33	I/O	DDC Bus data line to source
SCL_SINK	27	I/O	DDC Bus clock line to sink
SDA_SINK	28	I/O	DDC Bus data line to sink
VSADJ	35	I	TMDS Compliant voltage swing control(via 4.64k Ω to GND)
I ² CEN	6	I	I ² C Repeater enable Low : High-Z High : Active
SELREF	30	I	SCL_SINK/SDA_SINK Output voltage select
TEST0, 1, 2, 3	1, 12, 25, 36	I	Open or GND connect (recommend)
N.C	13, 48		Open or GND connect (recommend)
OEB	7	I	TMDS Output enable Low : Active High : High-Z
PRE	8	I	TMDS Output de-emphasis adjustment Low : OFF High : ON
V _{CC}	5, 14, 20, 29, 32, 41, 47	-	Power supply
GND	4, 9, 17, 23, 26, 31, 38, 44	-	Ground

●EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS

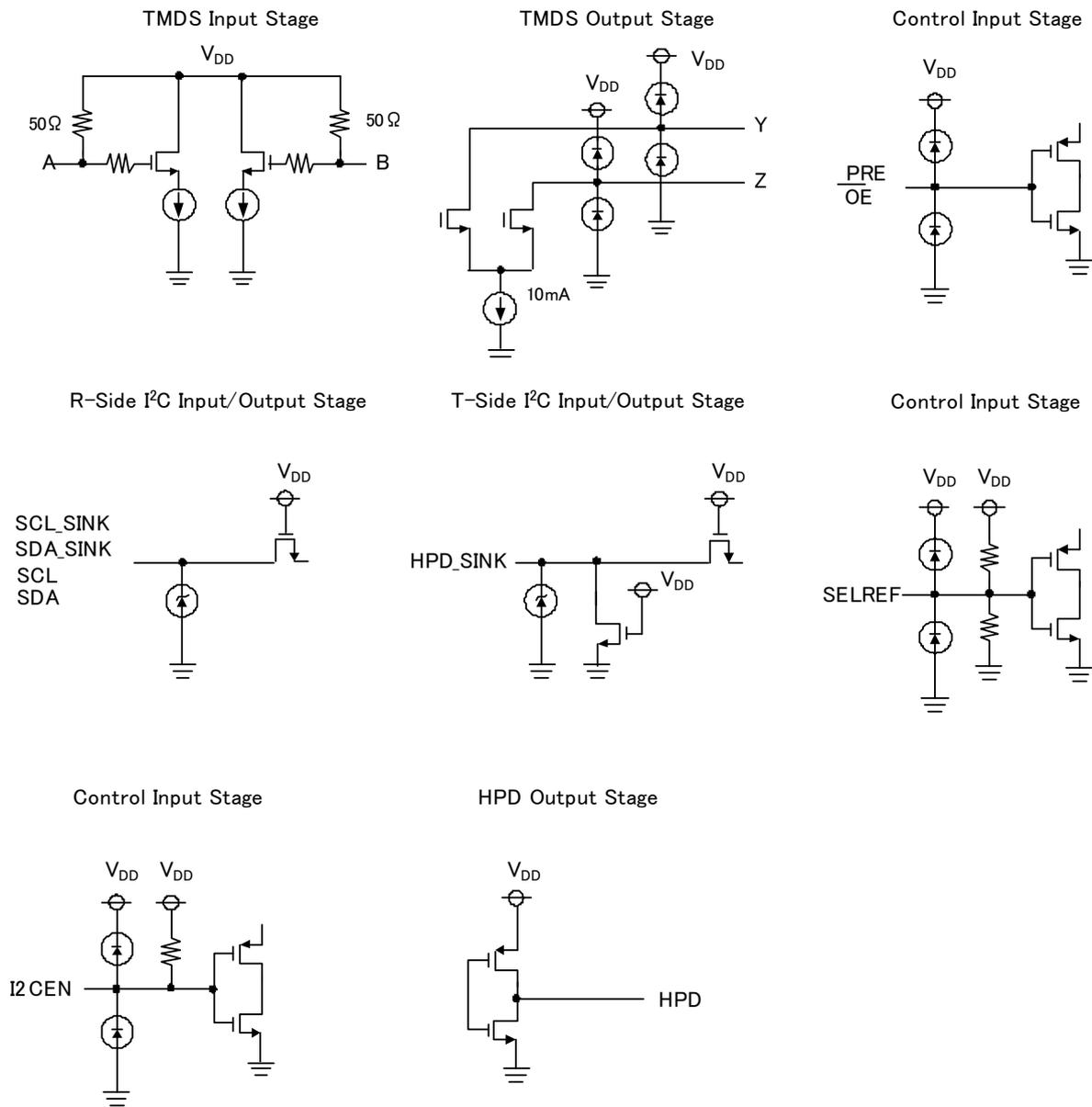


Fig4-1 I/O pin schematic diagram

● ELECTRICAL SPECIFICATIONS

1.) ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted)⁽¹⁾

ITEM	MIN.	TYP.	MAX.	UNIT
Supply voltage (V _{CC})	-0.3	-	4.0	V
SCL, SCL_SINK, SDA, SDA_SINK, HPD_SINK input voltage	-0.3	-	6.0	V
Differential input voltage	2.5	-	4	V
PRE, I ² CEN, SELREF, OEB input voltage	-0.3	-	4	V
Power dissipation	-	-	1200 ※1	mW
Storage temperature range	-55	-	125	°C

※70mm×70mm×1.6mm glass epoxy board mount. (Reverse Cu occupation rate: 15mm×15mm)

When it's used by than Ta=25°C, it's reduced by 12mW/°C.

2.) RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V _{CC}	Supply voltage	3.0	3.3	3.6	V
T _A	Operating free-air temperature	0	-	70	°C
TMDS DIFFERENTIAL PINS (A/B)					
V _{ID}	Receiver peak-to-peak differential input voltage	150	-	1560	mVp-p
V _{IC}	Input common mode voltage	V _{CC} -0.6	-	V _{CC} +0.01	V
R _{VSADJ}	Resistor for TMDS compliant voltage swing range	4.6	4.64	4.68	kΩ
AV _{CC}	TMDS output termination voltage, see Figure 5-1	3	3.3	3.6	V
R _T	Termination resistance, see Figure 5-1	45	50	55	Ω
Signaling rate		0	-	2.25	Gbps
CONTROL PINS (PRE, I²CEN, OEB)					
V _{IH}	LVTTL High-level input voltage	2	-	V _{CC}	V
V _{IL}	LVTTL Low-level input voltage	GND	-	0.8	V
CONTROL PINS (SELREF)					
V _{IH}	High-level input voltage	0.9V _{CC}	-	V _{CC}	V
V _{IL}	Low-level input voltage	GND	-	0.1V _{CC}	V
DDC I/O PINS (SCL, SCL_SINK, SDA, SDA_SINK)					
Tx (SDA_SINK, SCL_SINK)					
V _{IH}	High-level input voltage	2.1	-	5.5	V
V _{IL}	Low-level input voltage	-0.3	-	0.35	V
Rx (SDA, SCL)					
V _{IH}	High-level input voltage	2.4	-	5.5	V
V _{IL}	Low-level input voltage	-0.3	-	0.8	V
STATUS (HPD_SINK)					
V _{IH}	High-level input voltage	2.4	-	5.5	V
V _{IL}	Low-level input voltage	GND	-	0.8	V

3.) ELECTRICAL CHARACTERISTICS

Over recommended operating conditions (unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			MIN.	TYP. ⁽¹⁾	MAX.	
I _{CC}	Supply current	V _{IH} = V _{CC} , V _{IL} = V _{CC} -0.4V, R _{VSADJ} = 4.64kΩ R _T = 50Ω, AV _{CC} = 3.3V Am/Bm = 2.25 Gbps HDMI data pattern, m = 2,3,4 A1/B1 = 225 MHz clock	-	140	170	mA
P _D	Power dissipation	V _{IH} = V _{CC} , V _{IL} = V _{CC} -0.4V, R _{VSADJ} = 4.64kΩ R _T = 50Ω, AV _{CC} = 3.3V Am/Bm = 2.25Gbps HDMI data pattern, m = 2,3,4 A1/B1 = 225 MHz clock	-	480	700	mW
TMDS DIFFERENTIAL PINS (A/B; Y/Z)						
V _{OH}	Single-ended high-level output voltage	AV _{CC} = 3.3V, R _T = 50Ω, PRE = 0V	AV _{CC} - 10	-	AV _{CC} + 10	mV
V _{OL}	Single-ended low-level output voltage		AV _{CC} - 600	-	AV _{CC} - 400	mV
V _{SWING}	Single-ended low-level swing voltage		400	-	600	mV
V _{OD(O)}	Overshoot of output differential voltage		-	6%	15%	2xV _{swing}
V _{OD(U)}	Undershoot of output differential voltage		-	12%	25%	2xV _{swing}
V _{OD(pp)}	Steady state output differential voltage with de-emphasis	PRE = V _{CC} Am/Bm = 225 Mbps HDMI data pattern, m = 2,3,4 A1/B1 = 225 MHz clock	600	-	920	mVp-p
R _{INT}	Input termination resistance	V _{IN} = 2.9V	45	50	55	Ω
ΔV _{OC(SS)}	Change in steady-state common-mode output voltage between logic states		-	5	-	mV

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT	
			MIN.	TYP. ⁽¹⁾	MAX		
DDC Input and output							
Tx (SDA_SINK , SCL_SINK)							
I _{IKR①}	Input leak current,	V _I = 5.5V	-10	-	10	uA	
I _{IKR②}	Input leak current,	V _I = V _{CC}	-10	-	10	uA	
I _{OHT}	High-level output current	V _O = 3.6V	-10	-	10	uA	
I _{ILT}	Low-level input current	V _{IL} = GND	-10	-	10	uA	
V _{OVT}	Low-level output voltage	R _L = 4.7kΩ	SELREF = NC	0.43	-	0.57	V
			SELREF = GND	0.58	-	0.72	
			SELREF = V _{CC}	0.73	-	0.87	
V _{OVT} - V _{IL}	Low-level input voltage below output low-level voltage		SELREF = NC	-	100	-	mV
			SELREF = GND	-	250	-	
			SELREF = V _{CC}	-	400	-	
Rx (SDA, SCL)							
I _{IKR①}	Input leak current	V _I = 5.5V	-10	-	10	uA	
I _{IKR②}	Input leak current	V _I = V _{CC}	-10	-	10	uA	
I _{OHR}	High-level output current	V _O = 3.6V	-10	-	10	uA	
I _{ILR}	Low-level input current	V _{IL} = GND	-10	-	10	uA	
V _{OLR}	Low-level output voltage	I _{OUT} = 4mA	-	-	0.2	V	
STATUS PINS (HPD)							
V _{OH(TTL)}	TTL High-level output voltage	I _{OH} = -8mA	2.4	-	V _{CC}	V	
V _{OL(TTL)}	TTL Low-level output voltage	I _{OL} = 8mA	0	-	0.4	V	
CONTROL PINS (PRE, OEB)							
I _{IH}	High-level digital input current	V _{IH} = V _{CC}	-10	-	10	uA	
I _{IL}	Low-level digital input current	V _{IL} = GND	-10	-	10	uA	
CONTROL PINS (I²CEN, SELREF)							
I _{IH}	High-level digital input current	V _{IH} = V _{CC}	-45	-	45	uA	
I _{IL}	Low-level digital input current	V _{IL} = GND	-45	-	45	uA	
STATUS PINS (HPD_SINK)							
I _{IH}	High-level digital input current	V _{IH} = 5.5V	10	50	100	uA	
		V _{IH} = V _{CC}	5	30	80	uA	
I _{IL}	Low-level digital input current	V _{IL} = GND	-10	-	10	uA	

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			MIN.	TYP. ⁽¹⁾	MAX.	
TMDS DIFFERENTIAL PINS (Y/Z)						
t _{PLH}	Propagation delay time low-high-level output	See Figure5-2, AV _{CC} = 3.3V, R _T = 50Ω, PRE = "H"	-	320	-	ps
t _{PHL}	Propagation delay time high-low-level output		-	335	-	ps
t _r	Differential output signal rise time (20%-80%)		-	120	-	ps
t _f	Differential output signal fall time (20%-80%)		-	120	-	ps
t _{sk(p)}	Pulse skew (t _{PHL} - t _{PLH})		-	15	-	ps
t _{sk(D)}	Intra-pair differential skew, see Figure5-3		-	25	-	ps
DDC I/O PINS (SCL, SCL_SINK, SDA, SDA_SINK)						
t _{pdLHTR} (DDC)	Propagation delay time, low-to-high-level output Tx to Rx	R _L = 4.7KΩ C _L = 100pF	-	650	-	ns
t _{pdHLTR} (DDC)	Propagation delay time, high-to-low-level output Tx to Rx		-	200	-	ns
t _{pdLHRT} (DDC)	Propagation delay time, low-to-high-level output Rx to Tx	R _L = 1.67KΩ C _L = 400pF	-	500	-	ns
t _{pdHLRT} (DDC)	Propagation delay time, high-to-low-level output Rx to Tx		-	350	-	ns
t _r TX(DDC)	Tx output Rise time	R _L = 4.7KΩ C _L = 100pF	-	800	-	ns
t _f TX(DDC)	Tx output Fall time		-	150	-	ns
t _r RX(DDC)	Rx output Rise time	C _L =10pF	-	950	-	ns
t _f RX(DDC)	Rx output Fall time		-	50	-	ns
STATUS PINS(HPD)						
t _{pdLH(HPD)}	Propagation delay time, low-to-high-level output from HPD_SINK to HPD	C _L =10pF	-	5	-	ns
t _{pdHL(HPD)}	Propagation delay time, high-to-low-level output from HPD_SINK to HPD	C _L =10pF	-	5	-	ns
t _{sx(HPD)}	Switch time from port select to the latest valid status of HPD	C _L =10pF	-	8	-	ns

Note:

All typical values are at 25°C and with a 3.3V supply.

● MEASUREMENT SYMBOL AND CIRCUIT

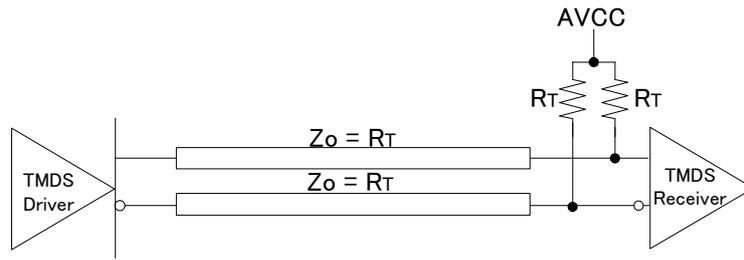


Figure 5-1. Termination for TMSD Output Driver

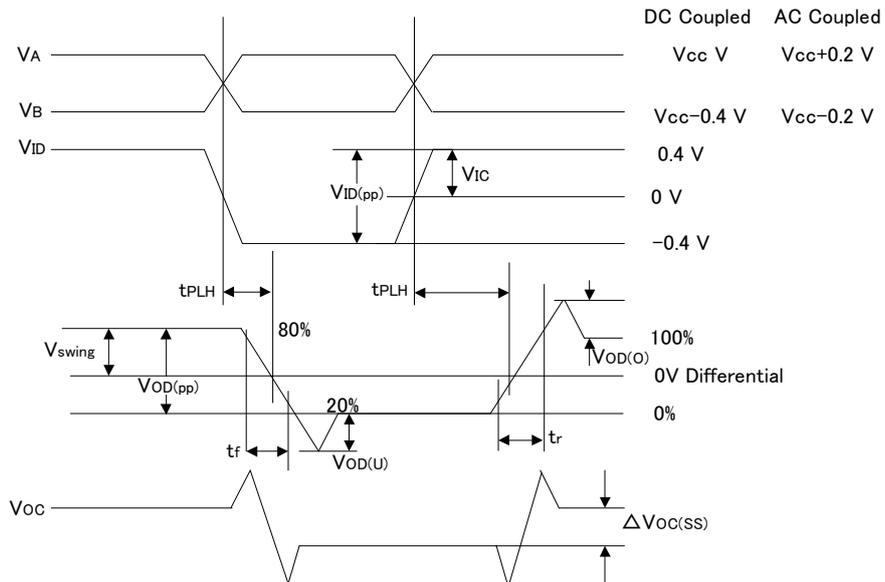
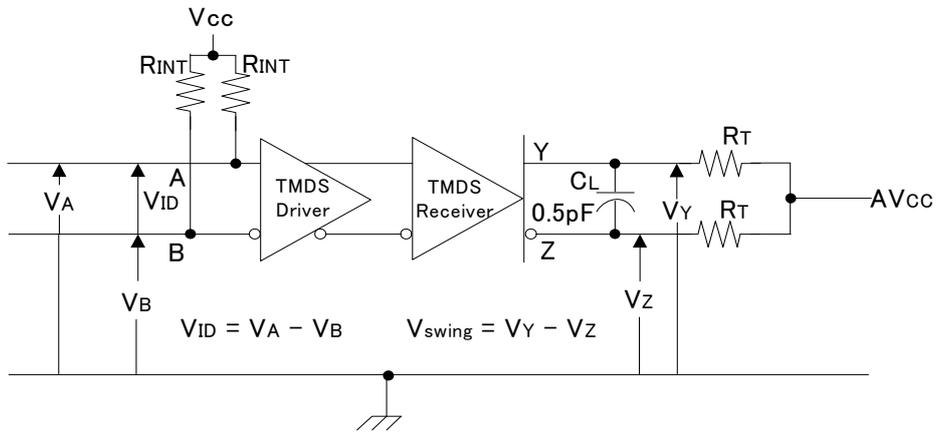


Figure 5-2. Timing Test Circuit and Definitions

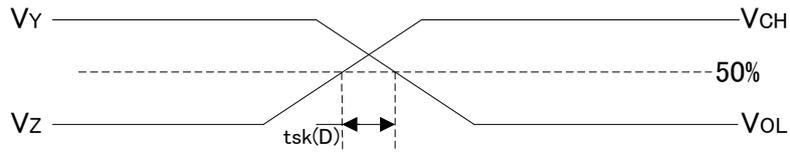


Figure 5-3. Definition of Intra-Pair Differential Skew

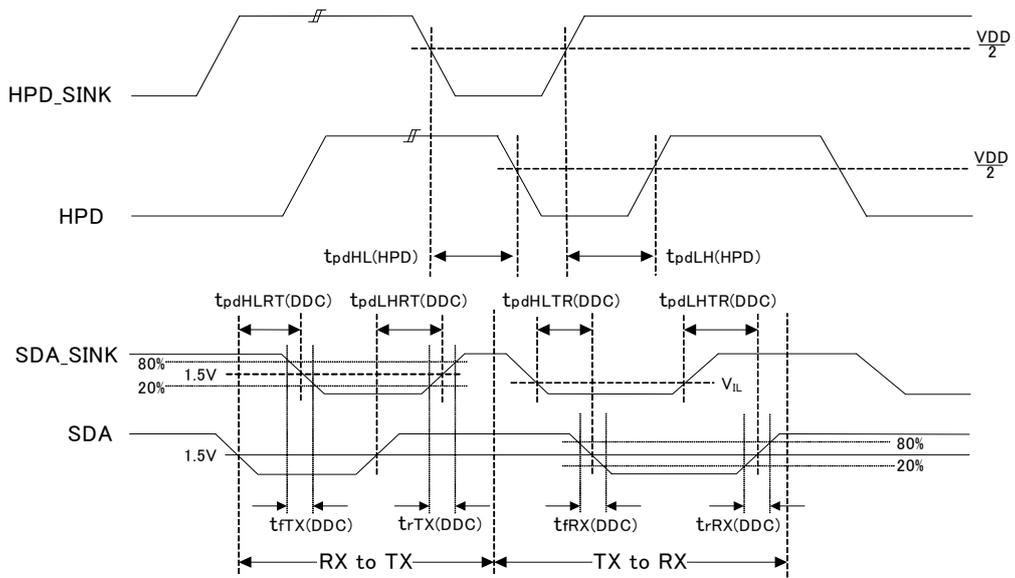


Figure 5-4. DDC and HPD Timing Definitions

1). Y and Z terminal ESD Diode notice.

Y and Z terminals are connected ESD diode.
 When $VCC + 0.4 < AVCC$.
 BU16024KV flow leak current from AVCC to VCC.
 In order to minimize leak current.
 Please use following application.
 If you use "Repeater" or "output Buffer"

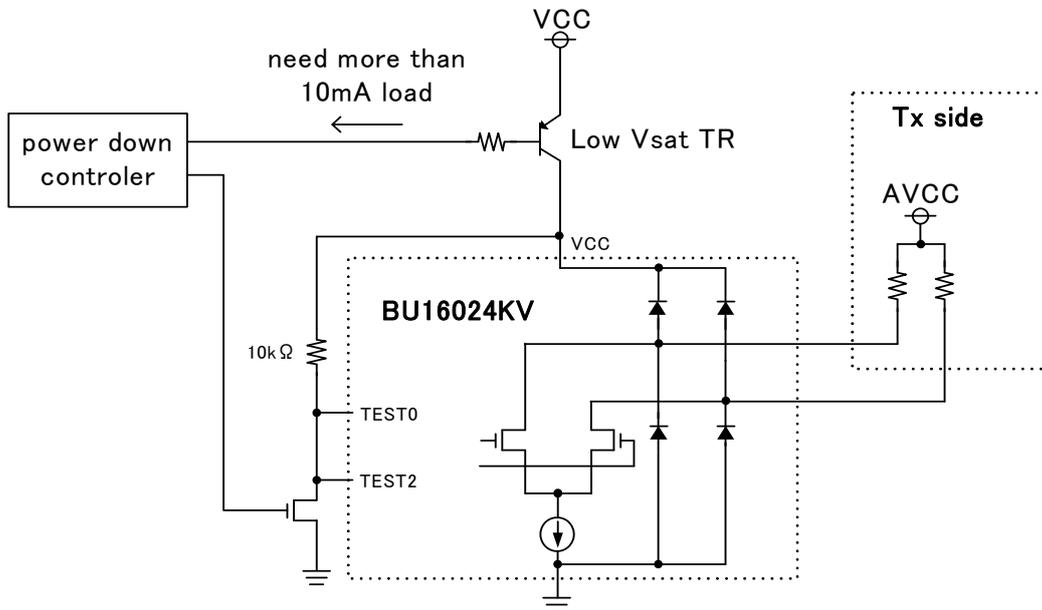


Fig6-1 Ist mode application

2). HPD_SINK Pull down resistance.

HPD_SINK is a 5V tolerant structure shown in Fig6-2.
 It needs some drive current to pull down HPD_SINK "H" to "L"(max10uA@HPD_SINK=2V).
 So to pull down HPD_SINK, please use 10kΩ (or under 10kΩ) resistor.

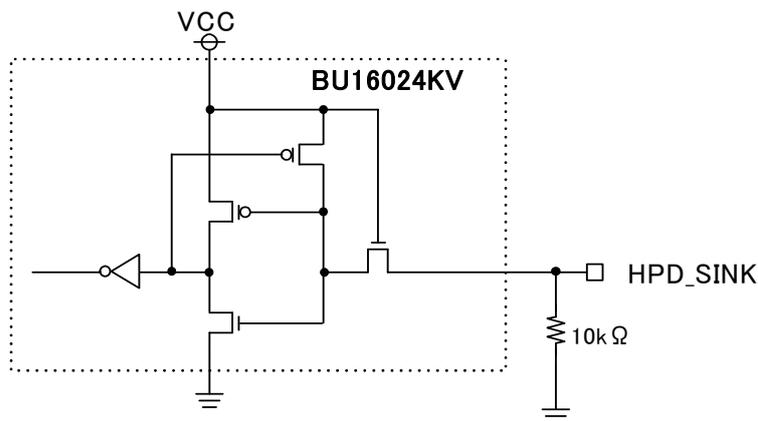


Fig6-2 HPD_SINK I/O schematic

3). About don't use terminal.

Unused TMDS input channel can be opened.

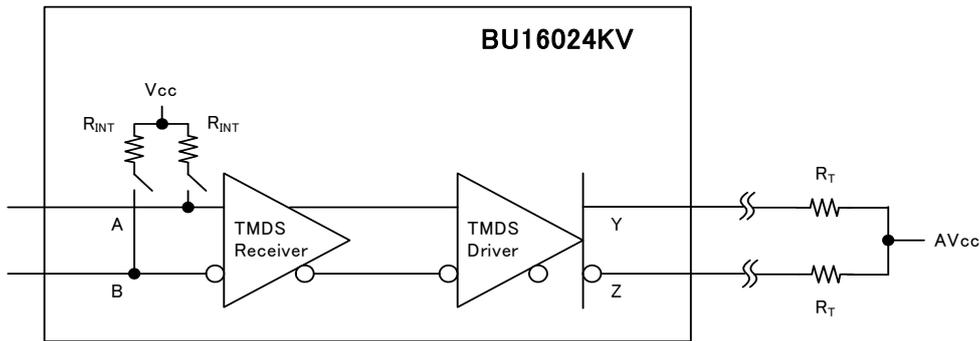


Fig6-3 TMDS Input Fail-Safe Recommendation

Unused DDC Buffers of R side pulled up to Vdd .

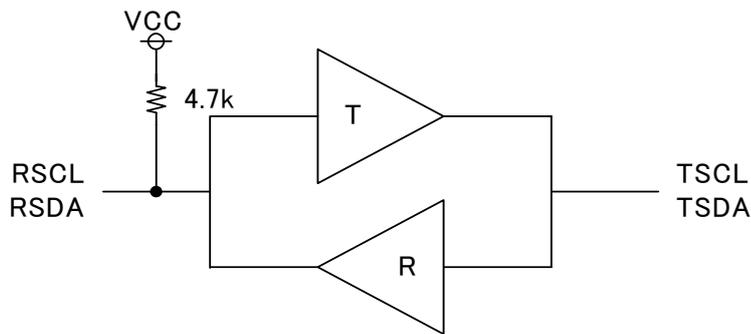


Fig6-4 DDC Buffers in BU16024KV

4). About serial connect notice.

When HDMI sw output connect to other HDMI sw input like following application.

There is possibility that. 1080p(12bit) image isn't displayed. It 's depend on receiver IC characteristic.

When system is required 1080p (12bit), Rohm doesn't recommend serial connect application.

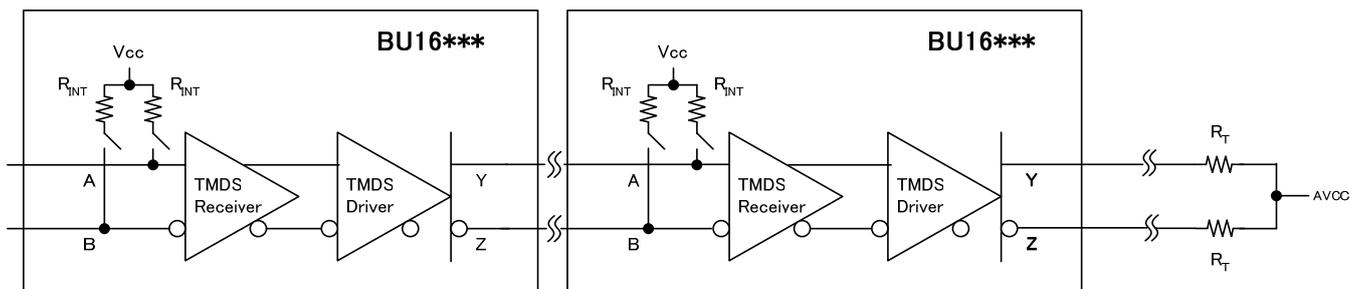
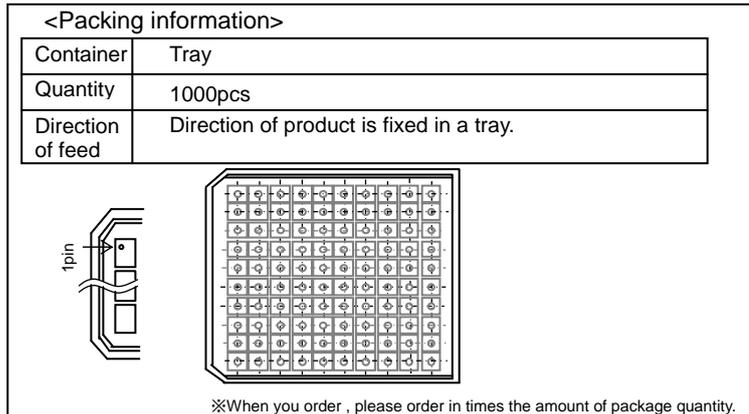
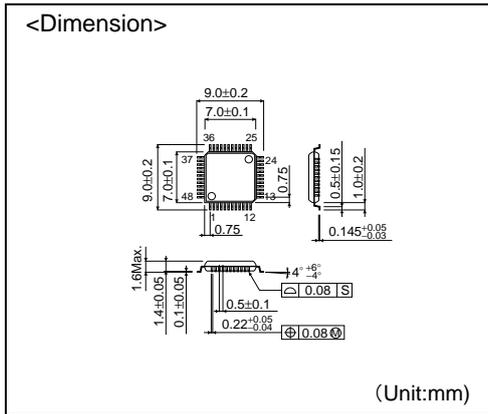
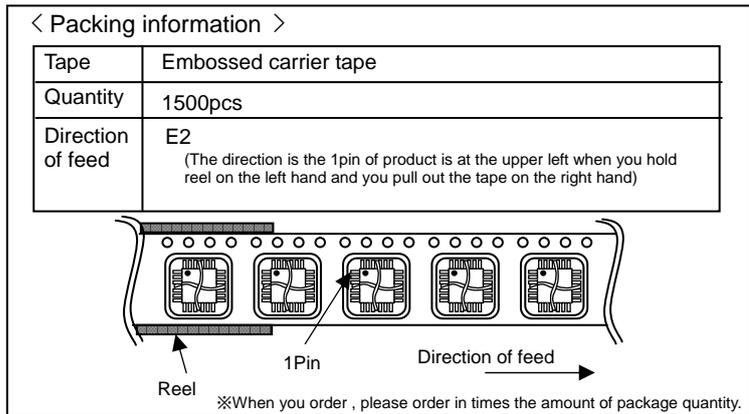
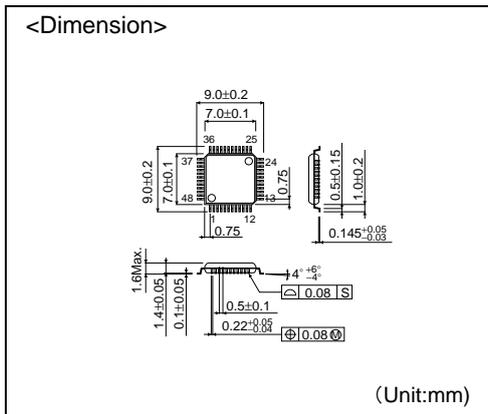


Fig6-5 serial connect notice

VQFP48C



VQFP48C



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Stuttgart	TEL: +49-711-7272-370	FAX: +49-711-7272-3720	Guangzhou	TEL: +86-20-3878-8100	FAX: +86-20-3825-5965
France	TEL: +33-1-5697-3060	FAX: +33-1-5697-3080	Huizhou	TEL: +86-752-205-1054	FAX: +86-752-205-1059
United Kingdom	TEL: +44-1-908-306700	FAX: +44-1-908-235788	Xiamen	TEL: +86-592-238-5705	FAX: +86-592-239-8380
Denmark	TEL: +45-3694-4739	FAX: +45-3694-4789	Zhuhai	TEL: +86-756-3232-480	FAX: +86-756-3232-460
Espoo	TEL: +358-9725-54491	FAX: +358-9-7255-4499	Hong Kong	TEL: +852-2-740-6262	FAX: +852-2-375-8971
Salò	TEL: +358-2-7332234	FAX: +358-2-7332237	Taipei	TEL: +886-2-2500-6956	FAX: +886-2-2503-2869
Oulu	TEL: +358-9-5372930	FAX: +358-8-5372937	Kaohsiung	TEL: +886-7-237-0881	FAX: +886-7-238-7332
Barcelona	TEL: +34-9375-24320	FAX: +34-9375-24410	Singapore	TEL: +65-6332-2322	FAX: +65-6332-5662
Hungary	TEL: +36-1-4719338	FAX: +36-1-4719339	Philippines	TEL: +63-2-807-6872	FAX: +63-2-809-1422
Poland	TEL: +48-22-5757213	FAX: +48-22-5757001	Thailand	TEL: +66-2-254-4890	FAX: +66-2-256-6334
Russia	TEL: +7-495-739-41-74	FAX: +7-495-739-41-74	Kuala Lumpur	TEL: +60-3-7958-8355	FAX: +60-3-7958-8377
Seoul	TEL: +82-2-8182-700	FAX: +82-2-8182-715	Penang	TEL: +60-4-2286453	FAX: +60-4-2286452
Masan	TEL: +82-55-240-6234	FAX: +82-55-240-6236	Kyoto	TEL: +81-75-365-1218	FAX: +81-75-365-1228
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