PRODUCT DATA SHEET

DQL-SE

DualLink Extension System

Revision History

Version Number	Revision Date	Page	Description of Changes
1.0	May.19.2008	ALL	Initial Version
1.1	Mar.15.2010	4	Self-EDID Function Added
1.2	Sep.08.2010	8	Optical Specification Added
1.3	Apr.09.2012	15	Ordering Information Removed
1.4	Nov.26.2019	ALL	Renewal Specification

PROPRIETARY NOTE

TABLE OF CONTENTS

1. General Description

DQL, optical dual link extension system, lets your Dual digital flat panel display signal extend up to 100 meters (330 feet) away from host by TMDS digital signal transmission.

▪ High speed and long distance transmission by LC type multimode fibers
  (Uses 7 strand multi mode LC fiber optic cable)
▪ Extends up to 100m
▪ It can support two mode for DDC
  - Real mode : Uses one CAT-5 cable for DDC
  - Emulation : Pseudo-DDC detection function for EDID information
▪ Self detecting function for EDID information
▪ It can support single link and dual link by selectable function switcher
▪ ESD protection

2. General Specification

Parameter	Symbol	
	Transmitter	**Receiver**
Optical Converter	7 ch 850 ㎚ Multi-mode VCSEL	7 ch GaAs PIN photo Diode
Input and Output Signal	TMDS Signal(DVI 1.0 standard)	TMDS Signal(DVI 1.0 standard)
Video Bandwidth	1.65Gbps / Channel	
Module Size	179.0×88.0×30.0 ㎜(W×H×D)	
Module Weight	0.46Kg	0.46Kg
Used electrical connector	24 PIN DVI-D Plug(input)	24 PIN DVI-D Plug(output)
Optical Connector	×7 LC Connector	×7 LC Connector
Recommended Fiber	50/125 ㎛ Multi-mode glass-fiber	
Link Connector	RJ-45 Jack	
Maximum Supported Resolution	-Single Link : WUXGA(1920x1200)60Hz -Dual Link : WQXGA(2560x1600)60Hz	

3. Absolute Maximum Ratings

Parameter	Rating
Storage temperature	-20°C ~ +70°C Non-Condensing
Operating temperature	0°C ~ +50°C Non-Condensing
Transportation temperature	-20°C ~ +70°C Non-Condensing
Power Supply	4.5 ~ 5.5 V
Relative Humidity	10 ~ 80 %
Lead solder temperature	260°C, 10 seconds

NOTICE

Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.   This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operations section for extended periods of time may affect reliability.

4. Electrical Specification
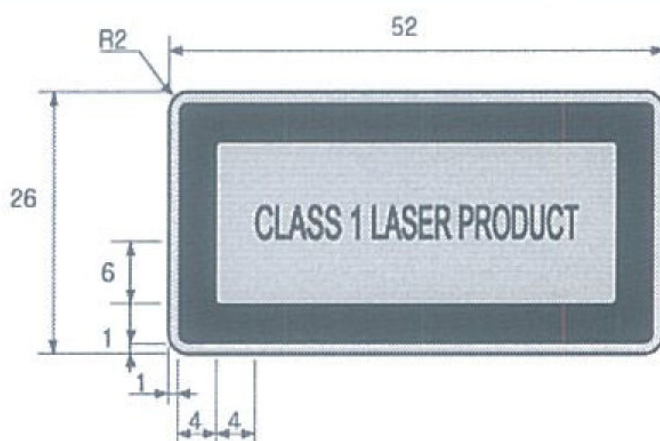
4.1 Electrical Specification

4.1.1 Transmitter Module

	Parameter	Symbol	Min	Typ	Max	Units	Condition
P O W E R	Supply Voltage (Option External Power)	Vcc		+5.0		V	
	Supply Current	Icc		280		mA	Dual
				200			Single
	Power Dissipation	Po		1.4		W	Dual
				1.0			Single
T M D S	Reference voltage for graphic signal	Vref	+3.1	+3.3	+3.5	V	
	Single-ended high level input voltage	VH	Vref-0.01		Vref+0.01	V	
	Single-ended low level input voltage	VL	Vref-0.6		Vref-0.4	V	
	Single-ended input swing voltage	Vswing	0.4		0.6	V	
	Single-ended standby input voltage		Vref-0.01		Vref+0.01	V	
	Data Output Load	RLD		50		Ohms	

Transmitter module of Model DQL includes 7 channel VCSEL(Vertical Surface Emitting Laser Diode) with 850 nm invisible laser radiation.

Do not view directly laser module of transmitter or the end of the other side of optical cable connected to transmitter with optical instrument.
Transmitter module of DQL is Class 1 Laser Product.

4.1.2 Receiver Module

	Parameter	Symbol	Min	Typ	Max	Units	Condition
P O W E R	Supply Voltage (External Power)	Vcc		+5.0		V	
	Supply Current	Icc		500		mA	
	Power Dissipation	Po		2.5		W	
T M D S	Reference voltage for graphic signal	Vref	+3.1	+3.3	+3.5	V	
	Single-ended output swing voltage	Voswing	0.4		0.6	V	AC couple
	Data Input Load	RLD		50		Ohms	

4.2 Optical Specification
4.2.1 Transmitter Characteristics

VCSEL Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Average Fiber Coupled Power	I_F = 7mA	P_{OC}		0.500		mW	2
Minimum coupling efficiency including wiggle	I_F = 7mA		55			%	
Threshold Current		I_{TH}	0.5	1.8	2.5	mA	
Threshold Current maximum deviation from 25°C value	$T_A = 0^{o}$C to 70°C	ΔI_{TH}	-0.5		1	mA	3
	$T_A = 25^{o}$C to 85°C	ΔI_{TH}			1.7	mA	3
	$T_A = -40^{o}$C to 25°C	ΔI_{TH}			2.5	mA	3
Temperature at minimum threshold current		T_O	-20		50	^{o}C	3
Slope Efficiency	$T_A = 25^{o}$C	η	0.25		0.8	mW/mA	4,5
Slope Efficiency Temperature variation	$T_A = 0^{o}$C to 70°C	$\Delta\eta/\Delta T$		-6000		ppm/^{o}C	6
Peak Wavelength	I_F = 7mA, $T_A = 0^{o}$C to 85°C	λ_P	830	850	860	nm	
λ_P Temperature Variation	I_F = 7mA, $T_A = -40^{o}$C to 85°C	$\Delta\lambda_P/\Delta T$		0.06		nm/^{o}C	
Spectral Bandwidth, RMS	I_F = 7mA	$\Delta\lambda$			0.65	nm	
Laser Forward Voltage	I_F = 7mA	V_F		1.8	2.0	V	
Rise and Fall Times	Pavg = 0.625mW, Extinction Ratio = 10	t_r t_f			130 150	ps	7
Relative Intensity Noise	1 GHz BW, I_F = 7mA	RIN		-130	-122	dB/Hz	
Series Resistance	I_F = 7mA , $T_A = 25^{o}$C	R_S	25	35	50	Ω	
	$T_A = -40^{o}$C	R_S	60			Ω	
	$T_A = 85^{o}$C	R_S	20			Ω	
Series Resistance Temperature Coefficient	I_F = 7mA, $T_A = 0^{o}$C to 70°C	$\Delta R_s/\Delta T$		-3000		ppm/^{o}C	8

Notes 1:

1) For the purpose of these tests, I_F is DC current.

2) Threshold current varies as $(T_A - T_O)^2$. It may either increase or decrease with temperature, depending upon relationship of T_A to T_O. The magnitude of the change is proportional to the threshold at T_O.

3) Slope efficiency is defined as $\Delta P_O / \Delta I_F$.

4) Product is sorted into 3 bins based on slope efficiency at $25\,^oC$ as follows:

Bin 1: 0.25 min, 0.4 max

Bin 2: 0.4 min, 0.6 max

Bin 3: 0.6 min, 0.8 max

5) To compute the value of Slope Efficiency at a temperature T, use the following equation:

$$\eta(T) \approx \eta(25\,^oC)*[1+(\Delta\eta/\Delta T)*(T-25)]$$

6) Rise and fall times specifications are the 20% - 80%. Most of the devices will measure <135ps fall time. Rise and fall times are sensitive to drive electronics.

7) To compute the value of Series Resistance at a temperature T, use the following equation:

4.2.2 Receiver Characteristics

Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Data Rate		DR	0.15		4.25	Gbps	
Supply Voltage			3.0	3.3	3.6	V	
Supply Current	PR =0µW, R L=50Ω AC coupled	Icc		30	45	mA	1
Optical Return Loss	PR =-12dBm	ORL	12			dB	1
Input Optical Wavelength	0oC to 70oC	λ_P	770	850	870	nm	
Maximum Average Input Power before Overload		P_{MAX}	0	+3		dBm	
Differential Output Voltage Swing	PR,OMA = -12Bm, AC Coupled to R L=50Ω	$V_{o(pk-pk)}$	100	150	220	mV	1,2
Differential Trans impedance	PR,OMA = -12dBm, AC Coupled to R L=50Ω	T	1500	2500	3500	V/W	1,2
-3dB Optical/Electrical Bandwidth	PR,OMA =-12dBm	BW	2		4	GHz	1,2,3
Low Frequency –3dB Cutoff	PR,OMA =-12dBm	BW LF			10	KHz	
Output Impedance		Z_{OUT}	42	50	58	Ω	
Output Return Loss	F<3GHz	S_{22}	8	12		dB	
RMS Input Referred Noise Equivalent Power	3.2GHz, 4 -pole BT Filter, PR=0uW (Dark), BER 10^ -12	NEP			20	µW, OMA	4
Sensitivity, OMA	DR = 1.0625, 1.25Gbps	S		-20	-17	dBm	5
	DR = 2.125, 2.5Gbps			-19	-16		
	DR = 3.125Gbps			-18	-16		
	DR = 4.25Gbps			-18	-15.5		
Stressed Sensitivity, OMA	DR = 1.0625, 1.25Gbps	Stressed		-17	-14	dBm	5,6
	DR = 2.125, 2.5Gbps			-16	-13		
	DR = 3.125Gbps			-14	-11		
	DR = 4.25Gbps			-14	-10.5		

Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Rise/Fall Time	PR,OMA =-12dBm, (20%-80%)	TR/TF		80	120	ps	2,7
Pulse Width Distortion		PWD			5	%	
Power Supply Rejection Ratio	PR =0μW (Dark), 5MHz<F<2GHz	PSRR	20			dB	1,8
Monitor Current Slope	PR =-12dBm	IMON	0.45	0.5	0.55	A/W	9
Monitor Current Offset	PR =0mW	IOFFSET			10	nA	
PD Bias Voltage		PDBIAS	Vcc -1	Vcc	Vcc+0.5	V	13
Group Delay	PR,OMA = -12dBm, AC Coupled to R L=50Ω 2MHz<F< 2GHz	Delay	-50		50	ps	10
Deterministic Jitter	PR,OMA = -12dBm, AC Coupled to R L=50Ω	DJTIA		30	40	ps	11
Random Jitter	PR,OMA = -12dBm, AC Coupled to R L=50Ω	RJTIA		3	5	ps	12

Notes 2:

1. PR is the average optical power at the fiber face.

2. PR,OMA is the peak to peak optical power at the fiber face (Optical Modulation Amplitude)

where ER is the extinction ratio (linear) of the optical source

$$P_{R,OMA} = \frac{2P_R(ER-1)}{ER+1}$$

3. Bandwidth and Low Frequency Cutoff are measured with a small signal sinusoidal light source with –12dBm average power

4. RMS input referred optical noise equivalent power is obtained by measuring the RMS output noise into a 1875 MHz, 4-pole Bessel-Thompson filter then dividing by the responsivity. A scaling factor of 14 is used to predict a BER of 10^{-12}

5. Sensitivity is measured with an optical source with an extinction ratio of 3dB.

6. Stressed receiver sensitivity is measured with 3.5dB vertical eye closure (intersymbol interference) and with 0.3UI of jitter added. The measurement technique is defined in IEEE 802.3ae.

7. Rise/Fall times are corrected for optical source Rise/Fall times. $T^2_{TIA} = T^2_{MEASURED} - T^2_{OPTICAL}$

8. Value shown is with no external power supply filtering.

9. The monitor current slope is measured as the current into the PDBIAS connection.

10. Group delay is a sensitive measurement to package interface, and includes the effects of PD, TIA and package. Measurement is made with TO leads as short as possible.

11. DJTIA is specified as contributed DJ by the TIA, obtained from $DJ^2_{TIA} = DJ^2_{TOTAL} - DJ^2_{OPTICAL}$

12. RJTIA is specified as contributed DJ by the TIA, obtained from $RJ^2_{TIA} = RJ^2_{TOTAL} - RJ^2_{OPTICAL}$

13. If external bias voltage is applied to VPD while VCC is externally unbiased, internal biasing of the TIA will occur, resulting in erroneous RSSI current.

4.3 Connector Pin Assignment
4.3.1 Transmitter

(Dual-mode)

Pin	Signal Assignment	Pin	Signal Assignment	Pin	Signal Assignment
1	T.M.D.S. Data2-	9	T.M.D.S. Data1-	17	T.M.D.S. Data0-
2	T.M.D.S. Data2+	10	T.M.D.S. Data1+	18	T.M.D.S. Data0+
3	T.M.D.S. Data2/4 Shield	11	T.M.D.S. Data1/3 Shield	19	T.M.D.S. Data0/5 Shield
4	T.M.D.S. Data4-	12	T.M.D.S. Data3-	20	T.M.D.S. Data5-
5	T.M.D.S. Data4+	13	T.M.D.S. Data3+	21	T.M.D.S. Data5+
6	DDC Clock (SCL)	14	+5V Power	22	T.M.D.S Clock Shield
7	DDC Data (SDA)	15	Ground (for +5V)	23	T.M.D.S Clock+
8	No Connect	16	Hot Plug Detect	24	T.M.D.S Clock-

(Single-mode)

Pin	Signal Assignment	Pin	Signal Assignment	Pin	Signal Assignment
1	T.M.D.S. Data2-	9	T.M.D.S. Data1-	17	T.M.D.S. Data0-
2	T.M.D.S. Data2+	10	T.M.D.S. Data1+	18	T.M.D.S. Data0+
3	T.M.D.S. Data2 Shield	11	T.M.D.S. Data1 Shield	19	T.M.D.S. Data0 Shield
4	No Connect	12	No Connect	20	No Connect
5	No Connect	13	No Connect	21	No Connect
6	DDC Clock (SCL)	14	+5V Power	22	T.M.D.S Clock Shield
7	DDC Data (SDA)	15	Ground (for +5V)	23	T.M.D.S Clock+
8	No Connect	16	Hot Plug Detect	24	T.M.D.S Clock-

4.3.2 Receiver

(Dual-mode)

Pin	Signal Assignment	Pin	Signal Assignment	Pin	Signal Assignment
1	T.M.D.S. Data 2-	9	T.M.D.S. Data 1-	17	T.M.D.S. Data 0-
2	T.M.D.S. Data 2+	10	T.M.D.S. Data 1+	18	T.M.D.S. Data 0+
3	T.M.D.S. Data2/4 Shield	11	T.M.D.S. Data1/3 Shield	19	T.M.D.S. Data0/5 Shield
4	T.M.D.S. Data 4-	12	T.M.D.S. Data 3-	20	T.M.D.S. Data 5-
5	T.M.D.S. Data 4+	13	T.M.D.S. Data 3+	21	T.M.D.S. Data 5+
6	DDC Clock (SCL)	14	Out +5V Power	22	T.M.D.S Clock Shield
7	DDC Data (SDA)	15	Ground (for out +5V)	23	T.M.D.S Clock+
8	No Connect	16	Hot Plug Detect	24	T.M.D.S Clock-

(Single-mode)

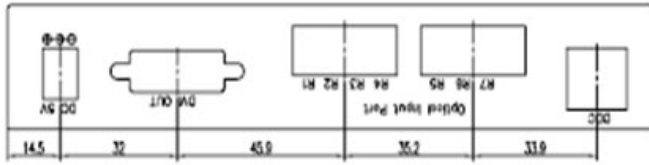| Pin	Signal Assignment	Pin	Signal Assignment	Pin	Signal Assignment
1	T.M.D.S. Data2-	9	T.M.D.S. Data1-	17	T.M.D.S. Data0-
2	T.M.D.S. Data2+	10	T.M.D.S. Data1+	18	T.M.D.S. Data0+
3	T.M.D.S. Data2 Shield	11	T.M.D.S. Data1 Shield	19	T.M.D.S. Data0 Shield
4	No Connect	12	No Connect	20	No Connect
5	No Connect	13	No Connect	21	No Connect
6	DDC Clock (SCL)	14	Out +5V Power	22	T.M.D.S Clock Shield
7	DDC Data (SDA)	15	Ground (for out +5V)	23	T.M.D.S Clock+
8	No Connect	16	Hot Plug Detect	24	T.M.D.S Clock-

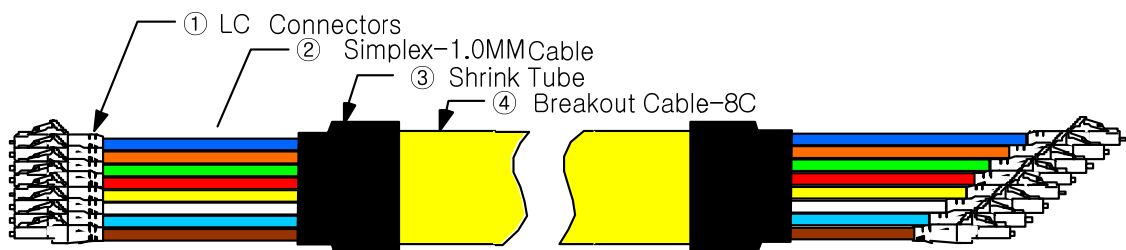## 5. Mechanical Specification
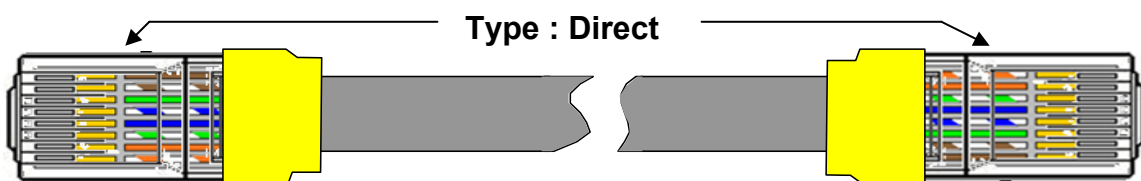5.1 Case Dimension
5.1.1 Transmitter
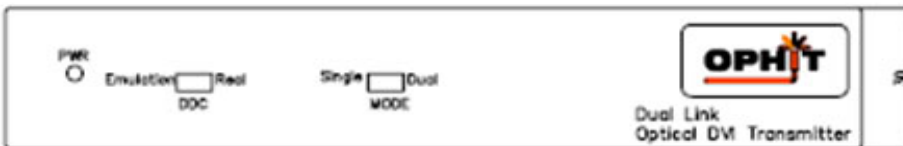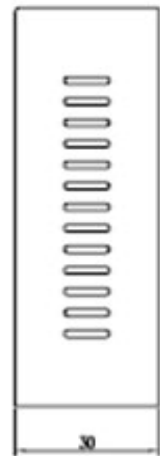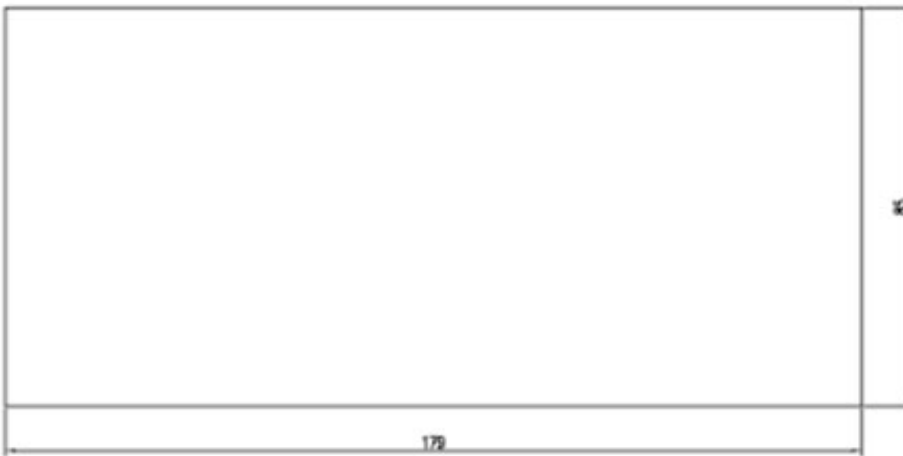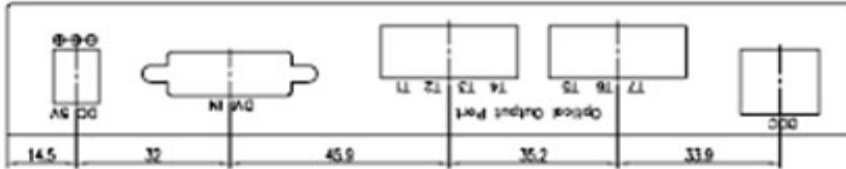
5.1.2 Receiver

5.2 Cable Information

▪ Optical Fiber Cable

① LC Connectors
② Simplex-1.0MMCable
③ Shrink Tube
④ Breakout Cable-8C

▪ UTP Cable Cat. 5 (RJ-45 Jack)

Type : Direct

5.3 Connection

7Ch Multi−mode optic fiber
w / LC connector
Up to 100M

LAN cable for DDC

PC

Transmitter

Receiver

Display
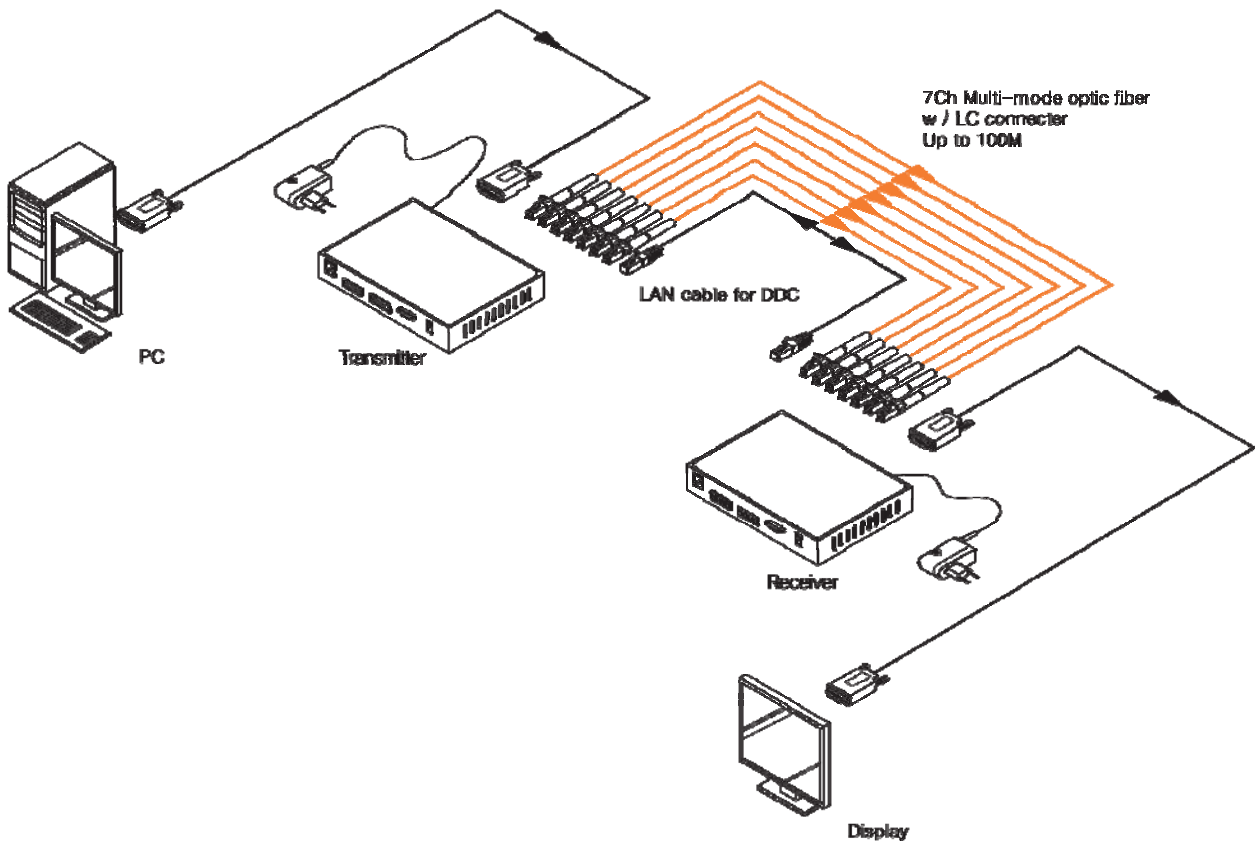
6. Regulatory
6.1 EMC & Safety Agency approval

6.1.1 CE-EMC compliance:
This Product is investigated to EN55022:2010, EN55024:2010 and EN61000-3-3:2008

6.1.2 FCC compliance:
This Product is investigated to FCC 47CFR part 2 and part 15

7. Packing Information

Unit(Unpacking, DQL Only)	179.0mm*88.0*30.0mm	465.0g
Package(1Unit, Inner Box Packing)	242.0mm*185.0mm*70.0mm	700.0g
Package(Multi, 15PCS Packing)	595.0mm*305.0mm*345.0mm	12.0Kg

8. RoHS

OPHIT is fully aware of the requirement under the **Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive EU 2015/863(RoHS3), which adds four new restricted substances to the previous Directive 2011/65/EU(RoHS2).**

Hereby we guarantee that we do not intentionally use the substances
described below and based on third party chemical analysis the thresholds of the substances as indicated are not exceeded for our all products.

Substance	CAS #	RoHS Limity by % (PPM)
Lead (PB)	7439-92-1	0.1% (1000 PPM)
Mercury (Hg)	7439-97-6	0.1% (1000 PPM)
Hexavalent Chromium (CrVI)	15840-29-9	0.1% (1000 PPM)
Polybrominated Biphenyls (PBB)	-	0.1% (1000 PPM)
Polybrominated Diphenyl Ethers (PBDE)	-	0.1% (1000 PPM)
Cadmium (Cd)	7440-43-9	0.01% (100 PPM)
Bis(2-Etylhexyl) phthalate(DEHP)	117-81-7	0.1% (1000 PPM)
Benzyl butyl phthalate(BBP)	85-68-7	0.1% (1000 PPM)
Dibutyl Phthalate(DBP)	84-74-2	0.1% (1000 PPM)
Disobutyl Phthalate(DIBP)	84-69-5	0.1% (1000 PPM)

Banned Substances by RoHS Directive 2011/65/EU+2015/863/EU, EN50581:2012

OPHIT will continue to monitor any new amendments/changes to Directive and subsequently review our all products with regards to compliance. OPHIT will also ensure that any new information is communicated to its customers, suppliers and stakeholders as required.

Signature : Jong-Kook, Moon
Title/Issue date : President/July.22.2019

9. REACH

The European REACH Regulation 1907/2006 on Registration, Evaluation, Authorization, and Restriction of Chemicals(REACH), Annex XVII entered into Force in June 2009, and affects all companies producing. Importing, using, or placing Products on the European market. The aim of the REACH regulation is to ensure a high Level of protection of human health and the environment from chemical substances.

OPHIT Co., Ltd substances management system follow and complies with the current revision of the REACH Regulation on the substances as identified by ECHA(European Chemical Agency).

OPHIT Co., Ltd products are considered articles as defined in REACH Article 3(3). These products/articles under normal and reasonable conditions of use do not have intended release of substances. Therefore the requirement in REACH Article 7(1)(b) for registration of substances contained in these products/articles does not apply.

OPHIT Co., Ltd products/articles, do not contain **Substances of very High Concern** or if there **SVHC** in the product/article, the content is less than the 0.1%(wt/wt) as defined by REACH Article 57, Annex XIV, Directive 67/548/EEC. Therefore the requirement in REACH Article 7(2) to notify ECHA if a product/article contains more than 0.1% wt/wt of an SVHC and tonnage exceeding 1 tone per importer per year is not applicable.
OPHIT's European operations do not manufacture or import chemicals, therefore
OPHIT Co., Ltd has no obligation to resister substances.

Jong-kook, Moon

Jong-Kook, Moon
President

OPHIT Co., Ltd ACCEPTS NO DUTY TO NOTIFY USERS OF THIS OF DECLARATION OF UPDATES OR CHANGES TO THIS DECLARATION.