Specification for

Model : DDI

Revised : Apr. 09. 2012
Original Release Date : May. 19. 2008

OPHIT

Revision History

Version Number	Revision Date	Author	Description of Changes
1.0	May 19, 2008	J.H Lee	Initial Version
1.1	June 30, 2008	J.H Lee	Optical SPEC Added
1.2	June 24, 2010	J.H. Lee	Fiber Cable Characteristics Modified
1.3	Mar 02, 2011	J.H Lee	Drawing Modified
1.4	Apr 09, 2012	J.H Lee	Ordering Information Removed

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1. General Description

DDI, unique fiber optical cable system, lets digital flat panel display signal extend up to 300 meter (984ft) away from host without any external power supply based on DVI standard.

- High Speed and long distance transmission by optical system
- Fully compatible with DVI 1.0 standard by DDWG
- Either external or internal power supply is possible
- External power supply is optional. Automatic power switch is include.
- DDC signal and 5V power line is transmitted by copper line
- No EMI characteristics for medical instruments and airplane

2. General Specification

Parameter	Symbol	
	Transmitter	Receiver
Optical Converter	4 ch 850 ㎚ Multi-mode VCSEL	4 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	39.5×15.0×71.21 ㎜(w×H×D)	
Module Weight	--	--
Electrical Connector	24 PIN DVI-D Plug(input)	24 PIN DVI-D Plug(output)
Recommended Fiber	50/125 ㎛ Multi-mode glass-fiber	

3. Absolute Maximum Ratings

Parameter	Rating
Storage temperature	-20°C ~ +70°C
Operating temperature	0°C ~ +50°C
Power Supply	-0.3 ~ 5.5 V
Relative Humidity	10 ~ 80 %
Lead-free solder temperature	260°C, 10 seconds

NOTICE

Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings 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 & Optical Specification

4.1 Electrical Specification

4.1.1 Transmitter Module

	Parameter	Symbol	Min	Typ	Max	Units	Condition
POWER	Supply Voltage	Vcc	+4.5	+5.0	+5.5	V	
	Supply Current	Icc		170	190	mA	
	Power Dissipation	Po		0.85	1.05	W	
TMDS	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	

4.1.2 Receiver Module

	Parameter	Symbol	Min	Typ	Max	Units	Condition
POWER	Supply Voltage	Vcc	+4.5	+5.0	+5.5	V	
	Supply Current	Icc		170	190	mA	
	Power Dissipation	Po		0.85	1.05	W	
TMDS	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°C to 70°C	ΔI_{TH}	-0.5		1	mA	3
	T_A = 25°C to 85°C	ΔI_{TH}			1.7	mA	3
	T_A = -40°C to 25°C	ΔI_{TH}			2.5	mA	3
Temperature at minimum threshold current		T_O	-20		50	°C	3
Slope Efficiency	T_A = 25°C	η	0.25		0.8	mW/mA	4,5
Slope Efficiency Temperature variation	T_A = 0°C to 70°C	$\Delta\eta/\Delta T$		-6000		ppm/°C	6
Peak Wavelength	I_F = 7mA, T_A = 0°C to 85°C	λ_P	830	850	860	nm	
λ_P Temperature Variation	I_F = 7mA, T_A = -40°C to 85°C	$\Delta\lambda_P/\Delta T$		0.06		nm/°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°C	R_S	25	35	50	Ω	
	T_A = -40°C	R_S	60	Ω			
	T_A = 85°C	R_S	20	Ω			
Series Resistance Temperature Coefficient	I_F = 7mA, T_A = 0°C to 70°C	$\Delta R_s/\Delta T$		-3000		ppm/°C	8

Notes 1:

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

3) 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.

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

5) Product is sorted into 3 bins based on slope efficiency at 25 ^{o}C 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

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

$\eta(T) \approx \eta(25\ ^{o}C)*[1+(\Delta\eta/\Delta\ T)*(T-25)]$

7) 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.

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

Notes 2:

Transmitter module of Model DDI includes 4 channel VCSEL(Vertical Surface Emitting Laser Diode) with 850 nm invisible laser radiation.

Transmitter module of DDI is Class 1 Laser Product.

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	λP	770	850	870	nm	
Maximum Average Input Power before Overload		PMAX	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 Transimpedance	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		ZOUT	42	50	58	Ω	
Output Return Loss	F<3GHz	S22	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	SStressed		-17	-14	dBm	5,6
	DR = 2.125, 2.5Gbps			-16	-13		
	DR = 3.125Gbps			-14	-11		
	DR = 4.25Gbps			-14	-10.5		
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	I_{OFFSET}			10	nA	
PD Bias Voltage		PD_{BIAS}	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	DJ_{TIA}		30	40	ps	11
Random Jitter	PR,OMA = -12dBm, AC Coupled to R L=50Ω	RJ_{TIA}		3	5	ps	12

Notes 3:

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

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

.

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

12. RJ_{TIA} 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 V_{PD} while V_{CC} is externally unbiased, internal biasing of the TIA will occur, resulting in erroneous RSSI current.

4.3 Connector Pin Assignment

▪ Model : DDI

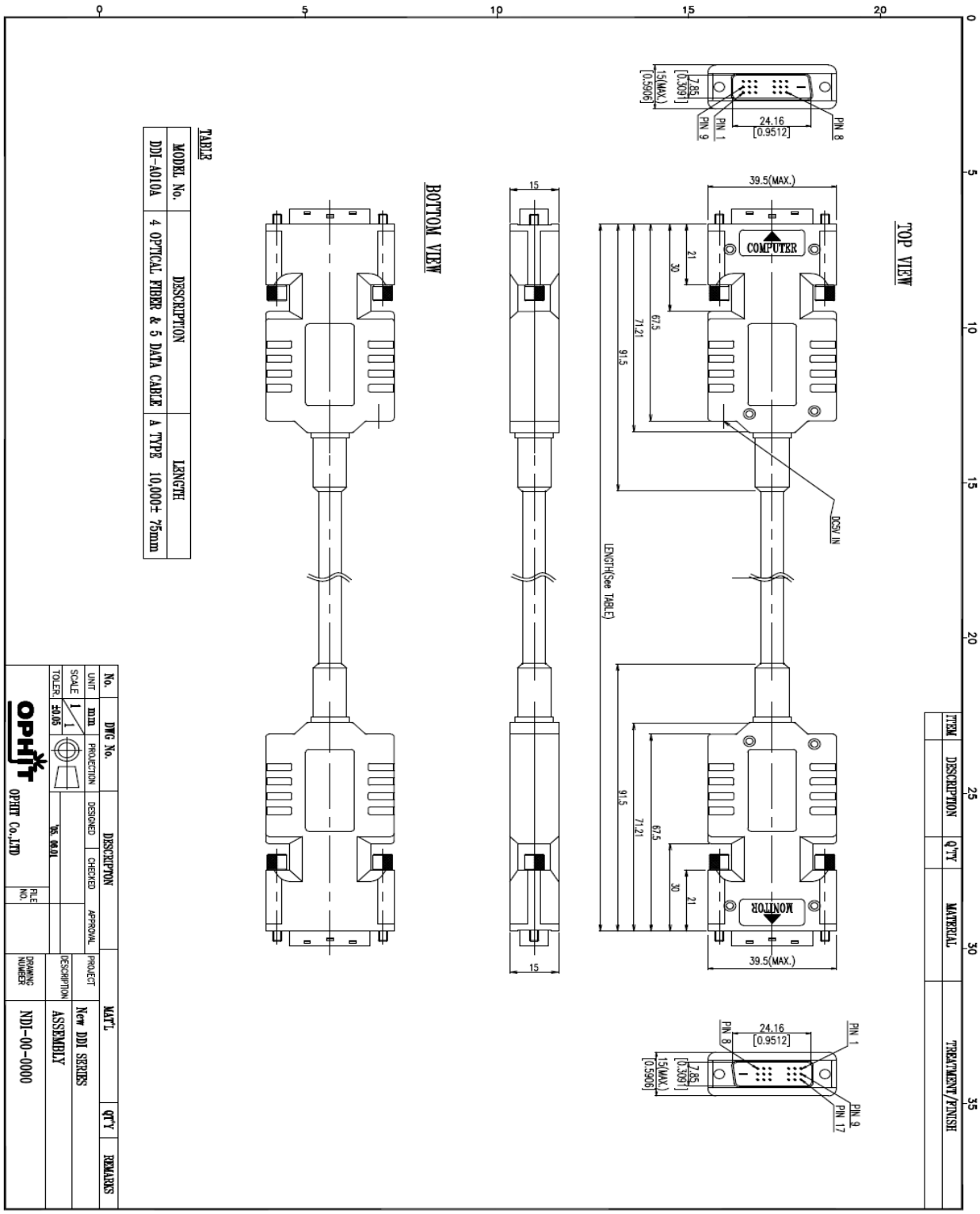
Fully compatible with DVI1.0 including of DDC and Hot Plug Detection

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	14	+5V Power	22	T.M.D.S Clock Shield
7	DDC Data	15	Ground (for +5V)	23	T.M.D.S Clock+
8	No Connect	16	Hot Plug Detect	24	T.M.D.S Clock-

*1 : 4 fiber & 5 Copper(Pin 6, 7, 14, 15, 16) line Cable Construction

5. Mechanical Specification

5.1 Case Dimension



5.2 Cable Information

The construction of 4 optical fibers and 4 copper wires cable shall be in accordance with Figure 1 and Table 1.

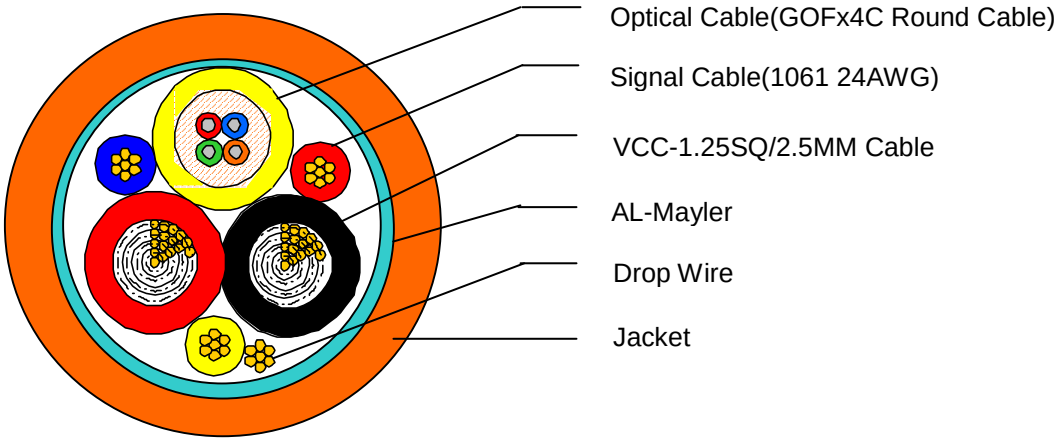


Figure 1. Cable structure of DDI

Table 1. Specification of electrical wire for DDI cable

The Dimension of DDI Cable		
Items	Unit	Specification
DVI Cable Make-up	-	Layer Stranding
Drain Wires (Size/Stranded)	mm(AWG)	-0.203/7 (24)
AL-Mylar Screen Shield	-	A helically
Cable Outer Diameter	mm	7.40±0.20
Jacket Color	-	FR-PVC(Orange)
Cable Marking	-	If need

The construction of 4 optical fibers and 4 copper wires cable shall be in accordance with Figure 2 and Table 2 and 3.

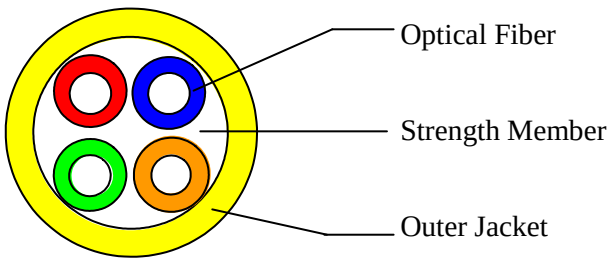


Figure 2. Cable structure of GOFx4C Round Cable

Table 2. Fiber Cable Construction

Item		Description
Optical Fiber	Number	4
	Structure	Figure 1
Strength Member		Aramid Yarn
Outer Jacket	Material	FR-PVC(Yellow)
	Approx.Thickness	1.6mm
Nominal Outside Diameter		ϕ4.0±0.4mm
Approximate Net Weight		10kg/km
Cable Identification		OPTICAL DDI CABLE

Table 3. Fiber Cable Characteristics

Item	spec.	unit	Condition
Storage Temperature	-40 ~ 70	°C	Spooled
Operational Test	-20 ~ 70	°C	-
Max. Tensile Load	245	N	By careless handling(short term)
Min. Radius Bend	75	mm	By careless handling(short term)
	150		After installing(long term)
Crush Resistance	490	N/50mm	By careless handling(short term)

6. RoHS

Certificate of Conformance RoHS

Dear Customer,

On January 27, 2003, the European Parliament and the Adminstrative Council adopted Directive 2002/95/EC (RoHS) that concerns the **"**Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment**"**.

The parts currently delivered by **OPHIT CO., LTD.** are already free of lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (Cr^{6+}), polybrominated biphenyl (PBB) and polybrominated diphenyl (PBDE).

This Certification of Conformance is to certify that the products listed below comply with RoHS Directive mentioned above:

- DDI

If you have any further questions regarding the RoHS compliance of parts delivered by **OPHIT CO., LTD.**, please do not hesitate to contact us at **support@ophit.com**.

Best regards,

JONG-KOOK MOON/CEO

OPHIT CO., LTD.