

Hybrid-PIO Integrated Specification

* There is a possibility of radio wave interference during the operation of corresponding radio equipment

Revision 2.00
August, 24, 2023

Updated By: KM. JO

Approval Signatures :	☐ Name (Job Position)	☐ Name (Job Position)	☐ Name (Job Position)
	Date:	Date:	Date:

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Revision History:

Rev.	Date/Initials	Location	Description of Change
2.0	2023. 08. 24./ HC.Choi	All	- First Released

1. PRODUCT INTRODUCTION

Hybrid-PIO is a communication device to be used when transmitting and receiving the 8 bit I/O signals in compliance with the Semi-conductor SEMI-E84/E23 protocol standard regulation, which is a complex communication device that unifies both 2GHz/5GHz ***RF (wireless)*** and ***IR (Infrared ray, Optical)*** communication media in one unit.

This is a product designed to be able to achieve the operation in optimal state even in poor communication environment. Various and convenient additional functions can be configured using RS-232 and radio transmission functions, and the communication media can be converted to IR or RF automatically depending on the operation environment.

Additionally, various functions are provided so that the fast cause analysis and counter actions can be taken when transmitting / receiving the data during communication.

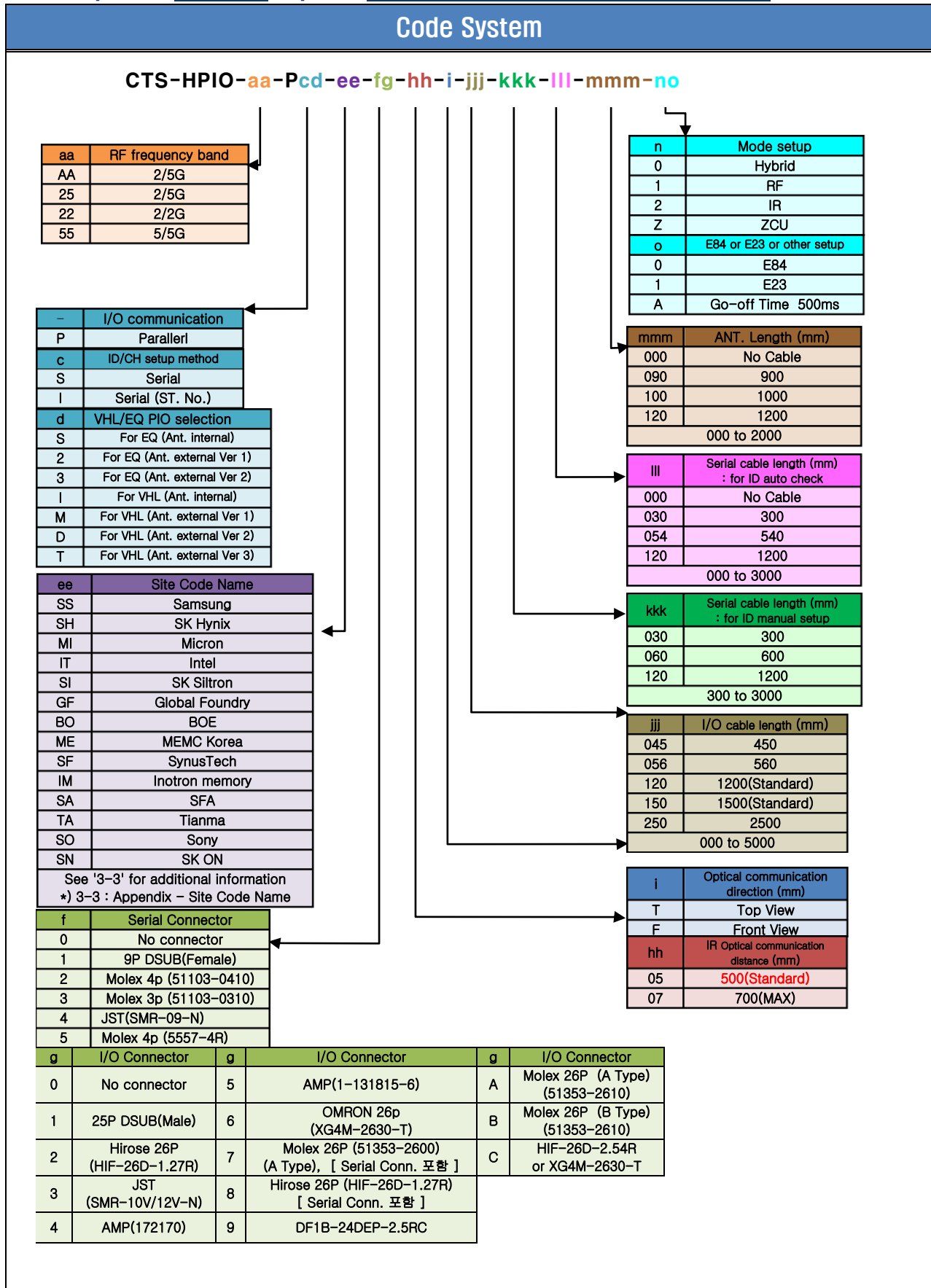
This device is to be used mainly for the exchange of control signals between the Vehicles (Master or Active devices such as AGV/OHT, etc.) and equipment (Slave or Passive devices).

2. CHARACTERISTICS OF THE PRODUCT

- This product exchanges 8 bit I/O signals using non-contact type technology.
- RF (2GHz/5GHz) and IR (Infrared ray, Optical) communication media are unified in one unit
- RF can be used with IR and it can be converted automatically depending on the type of operation without separate configuration of communication media.
- Auto evasion function can be activated when there is electromagnetic noise interference.
- Both 1 & 2 Way communication methods can be applied
 - RF (wireless) communication of both 1st and 2nd Slaves can be realized simultaneously on a real time basis using one Master device.
- Standard radio communication distance: up to 3.5 M
 - ※ Cautions: No obstacles and electromagnetic interferences could be allowed between the communication devices, and the communication distance may be reduced due to the influence of the environment.
- Approx. 100 different operations such as communication data and errors, absolute time, strength of signals, etc. can be analyzed using logging function (this will be removed when power is turned off).
- Options such as Setup, Log DownLoad, Emulation communication, etc. can be configured remotely using wireless remote controller iMAN⁺ (Handy TP).
- Easy installation by attaching a bracket on the equipment and there is no safety issues at all.
- Operation cost and time can be reduced drastically if wireless equipment is used as there is no need of duct removing work when moving the equipment.
- Special specifications are recommended for high-rise EUV lines
 - CTS-HPIO-AA
- Implementation of DC Code function: ST. NO. ID/CH automatic generation method using [Mapless method]
 - F/W Ver. Available on x.29 and above
 - Master PIO: Can be mixed with existing ID/CH method [CTS-HPIO-xx-PSM]
 - Slave PIO: When Master PIO uses DC Code, Slave can communicate only in Mapless method [CTS-HPIO-xx-PIS]

3. PRODUCT CODE CONFIGURATION

3-1. Map Data [ID/CH] / Mapless [ST. NO. Mode (RS-232) / ST. NO. Mode (I/O)]



❖ EXAMPLE OF PRODUCT CODE]

Classification	Code																																																												
EQ (Slave, Passive)	CTS-HPIO-25-PSS-SS-11-05-F-125-030-000-000-00 <table><tr><td>aa</td><td>RF frequency band</td></tr><tr><td>25</td><td>2/5G</td></tr></table><table><tr><td>-</td><td>I/O communication</td></tr><tr><td>P</td><td>Parallerl</td></tr></table><table><tr><td>c</td><td>ID/CH setup method</td></tr><tr><td>S</td><td>Serial</td></tr></table><table><tr><td>d</td><td>VHL/EQ PIO Selection</td></tr><tr><td>S</td><td>For EQ (Ant. internal)</td></tr></table><table><tr><td colspan="2">Site Code Name</td></tr><tr><td>SS</td><td>Samsung</td></tr></table><table><tr><td>f</td><td>Serial Connector</td></tr><tr><td>1</td><td>9P DSUB(Female)</td></tr></table><table><tr><td>g</td><td>I/O Connector</td></tr><tr><td>1</td><td>25P DSUB(Male)</td></tr></table><table><tr><td>n</td><td>Hybrid or RF Mode setup</td></tr><tr><td>0</td><td>Hybrid</td></tr></table><table><tr><td>o</td><td>E84 or E23 or other setup</td></tr><tr><td>0</td><td>E84</td></tr></table><table><tr><td>mmm</td><td>ANT. Length (mm)</td></tr><tr><td>000</td><td>No Cable</td></tr></table><table><tr><td>lll</td><td>Serial cable length (mm) : for ID auto check</td></tr><tr><td>000</td><td>No Cable</td></tr></table><table><tr><td>kkk</td><td>Serial cable length (mm) : for ID manual setup</td></tr><tr><td>030</td><td>300</td></tr></table><table><tr><td>jjj</td><td>I/O cable length (mm)</td></tr><tr><td>125</td><td>1250</td></tr></table><table><tr><td>i</td><td>Optical communication direction</td></tr><tr><td>F</td><td>Front View</td></tr></table><table><tr><td>hh</td><td>IR Optical communication distance (mm)</td></tr><tr><td>05</td><td>500</td></tr></table>	aa	RF frequency band	25	2/5G	-	I/O communication	P	Parallerl	c	ID/CH setup method	S	Serial	d	VHL/EQ PIO Selection	S	For EQ (Ant. internal)	Site Code Name		SS	Samsung	f	Serial Connector	1	9P DSUB(Female)	g	I/O Connector	1	25P DSUB(Male)	n	Hybrid or RF Mode setup	0	Hybrid	o	E84 or E23 or other setup	0	E84	mmm	ANT. Length (mm)	000	No Cable	lll	Serial cable length (mm) : for ID auto check	000	No Cable	kkk	Serial cable length (mm) : for ID manual setup	030	300	jjj	I/O cable length (mm)	125	1250	i	Optical communication direction	F	Front View	hh	IR Optical communication distance (mm)	05	500
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3-2. Serial Type

Code System

CTS-HPIO-aa-bcd-ee-fg-hh-i-jjj-kkk-lll-mmm-no

aa	RF frequency band
AA	2/5G
25	2/5G
22	2/2G
55	5/5G

b	I/O communication
5	RS-485
2	RS-232
c	ID/CH setup method
S	Serial
d	VHL/EQ PIO selection
S	For EQ (Ant. internal)
M	For VHL (Ant. external Ver 1)

ee	Site Code Name
SS	Samsung
SH	SK Hynix
MI	Micron
IT	Intel
SI	SK Siltron
GF	Global Foundry
BO	BOE
ME	MEMC Korea
SF	SynusTech
IM	Inotron memory
SA	SFA
TA	Tianma
SO	Sony
SN	SK ON
See '3-3' for additional information	
*) 3-3 : Appendix - Site Code Name	

f	Maint Serial Connector
0	No connector
1	9P DSUB (Female)
g	I/O Serial Connector
0	No connector
1	9P DSUB (Female)
2	43025-0400
3	RJ11 _ G PIN Type
4	RJ11 _ H PIN Type

n	Mode setup
0	Hybrid
1	RF
2	IR
3	16 B.COM (Hy)
4	32 B.COM (Hy)
C	2 단 STB 용_ CFI (Hy)
S	2 단 STB 용_ SEMES (Hy)
P	Puzzle STB 용 (Hy)
G	G company (IR)
H	H company (IR)
o	E84 or E23 or other setup
0	E84
1	E23
T	Taget

mmm	ANT. Length (mm)
000	No Cable
090	900
100	1000
120	1200
000 to 2000	

lll	Serial cable length (mm) : for ID auto check
000	No Cable
030	300
054	540
120	1200
000 to 3000	

kkk	Serial cable length (mm) : for ID manual setup
030	300
060	600
120	1200
300 to 3000	

jjj	I/O cable length (mm)
200	2000(Standard)
250	2500
000 to 5000	

i	Optical communication direction
T	Top View
F	Front View
hh	IR Optical communication distance (mm)
05	500(Standard)
07	700(MAX)

❖ EXAMPLE OF PRODUCT CODE]

Classifi cation	Code	
Serial Hybrid PIO	CTS-HPIO-25-2SS-SS-11-05-F-250-030-000-000-00	
	aa	RF frequency band
	25	2/5G
	b	I/O communication
	2	RS-232
	c	ID/CH setup method
	S	Serial
	d	VHL/EQ PIO Selection
	S	Ant. 내장
	Site Code Name	
SS	Samsung	
f	Serial Connector	
1	9P DSUB(Female)	
g	I/O Connector	
1	9P DSUB(Female)	
	n	Mode setup
	0	Hybrid
	o	E84 or E23 or other setup
	0	E84
	mmm	ANT. Length (mm)
	000	No Cable
	lll	Serial cable length (mm) : for ID auto check
	000	No Cable
	kkk	Serial cable length (mm) : for ID manual setup
	030	300
	jjj	I/O cable length (mm)
	200	2000
	i	Optical communication direction
	F	Front View
	hh	IR Optical communication distance (mm)
	05	500

4. MAIN SPECIFICATION

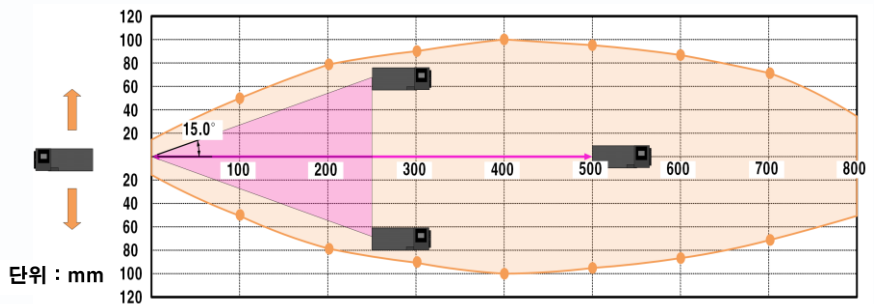
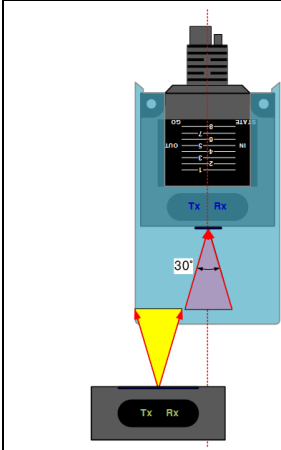
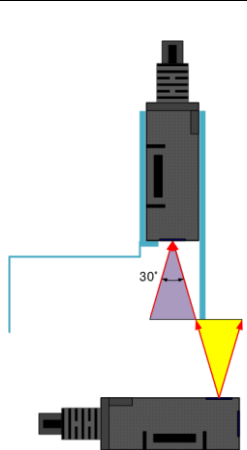
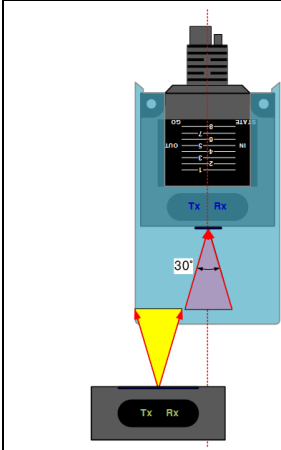
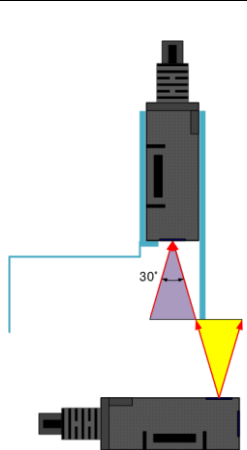
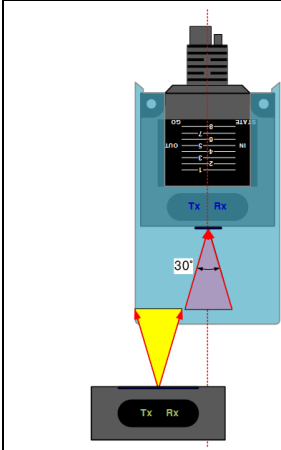
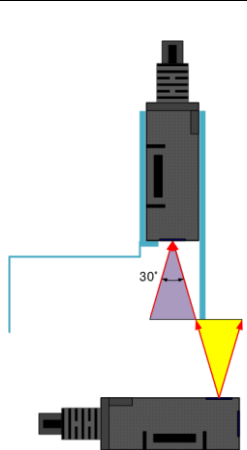
4-1. LED Indicator

Item		Meaning
1~8	IN	• Display the operation status of the HPIO input signal. It turns on when the input is low.
	OUT	• Display the output status of HPIO, which turns on when TR is on.
GO		• Will be turned on when there is data transmission & reception between the HPIO Master and Slave,
STATE		• HPIO state information signal • *) Refer to STATE LED operation timing
Indicators configuration		STATE : HPIO operation state IN : HPIO Input signal OUT : HPIO output signal GO : Connection of HPIO communication 고정홀 2 개 *) Master/Slave same indicator configuration
STATE LED Operation timing		Master 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0.25Sec 1.25Sec Repeat ON OFF Slave 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 1Sec 5Sec 5Sec Repeat ON OFF

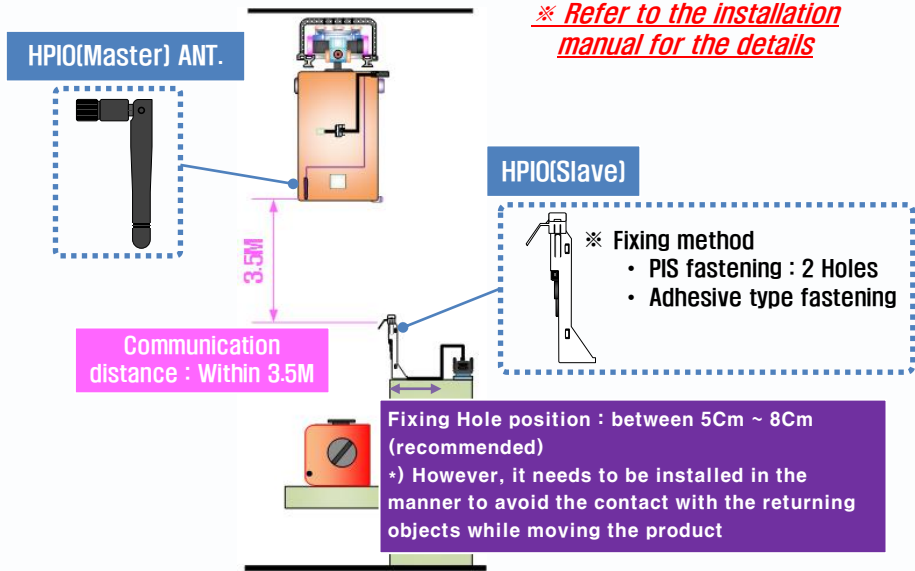
4-2. RF Communication

Item		Main Contents
Main functions		8 bit I/O Data communication - Setup, Log Download, Emulation option setup, etc.
Communication media		2GHz and 5GHz ISM Band, Band width 1MHz
Frequency band	2GHz	2.400~2.525GHz, 126 channels^{·1)} 5.725~5.852GHz, 128 channels^{·1)}
	5GHz	<i>·1) Specification needs to be discussed depending on the frequency band standard of each country</i>
Communication speed		1 Mbps/channel of High speed data communication
Communication strength		Max. RF output : 2.4GHz : 30 dBm below / 5.8GHz : 30 dBm below <i>·1) Specification needs to be discussed depending on the frequency band standard of each country</i>
Communication cycle		Approx. 20~30ms
Communication method		1:1 Communication, Half Duplex
Modulation method		GFSK type modulation, 1 MHz of band width
Safety function		Serial Number (ID) can be identified, CRC-16
Operation distance		- Within 3.5M: Lineal distance between Master antenna and Slave ·1) Refer to the installation place of HPIO on Page 11. ❖ Cautions - Be careful not to locate a metal obstacle on the lineal distance between HPIO Master and Slave - Be careful not to locate a metal obstacle within at least 60mm of antenna - Be careful not to use in an environment when radio device and electromagnetic wave interference is existed. - Shield the electromagnetic wave from the adjacent device before use if there is an electromagnetic wave radiating equipment such as magnetron. - It is recommended to keep at least 50Cm of distance when multiple HPIOs (Slave) are installed on the equipment. <i>·1) It is necessary to check the site radio communication environment before installing the HPIO</i>
Radio ID setup	Master	“Mapless” Setup Method - ST. NO. Mode (RS-232): You can set the wireless ID through RS-232 communication - ST. NO. Mode (I/O): You can set the wireless ID through I/O communication - Bridge Mode: You can set the ST NO. using wireless ID through BCR (QR) Data <i>·1) Channel will be generated automatically, and “same layer classification setup” needs to be used when St. NO. is used duplicate.</i>
		“Map Data” Setup Method Wireless ID and channel can be set through RS-232 communication <i>·1) ID/CH needs a map and cannot be used with identical ID/CH</i>
	Slave	Can be set using wireless remote controller (iMAN⁺) or PC.
	Common	- Frequency range: Default setup with 2 wireless LAN band width channels (40MHz) - Frequency setup distance: 3MHz (default) ·1) It is set with factory default value when shipping the product and the set values can be changed later.
	Others	<i>Details will be provided as a reference document depending on the line condition.</i>

4-3. IR Communication

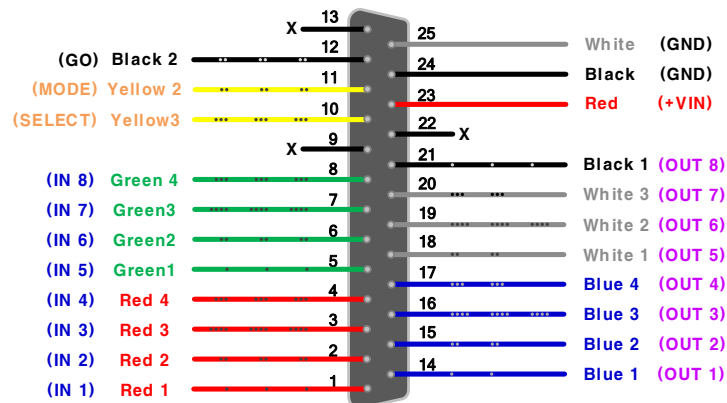
Item	Main Contents				
Main Function	8bit I/O Data Communication +) IR noise shielding function				
Communication Media	870nm, Infrared				
Communication Range	- Distance : 0.5m (0°), 0.25m (± 15°) / Angle : 30° (± 15°) +) Setup value can be changed up to 0.7M from the center				
Communication Method	1:1 Communication, Half Duplex				
Communication Cycle	Approx. 23 ms				
Communication window place	T Type : Top View / F Type : Front View +) option can be selected				
Optical modulation method	Pulse Modulation				
Communication Error Check	Parity				
Ambient Brightness	A place with light bulb or fluorescent light lower than 4000 lx and no direct sunlight				
IR Communication Range Measurement	- IR communication range measurement data – There is a possibility of communication interference when light, sunlight, IR remote controller, optical sensor, etc. is facing at the transmission window, and in this case, a measure to shield the lights from outside need to be taken before use.  단위 : mm				
Cautions during installation	❖ <u>Example of correct use : Install the device based on the center position</u> <table border="1"> <thead> <tr> <th>Front View</th><th>Side View</th></tr> </thead> <tbody> <tr> <td></td><td></td></tr> </tbody> </table>	Front View	Side View		
Front View	Side View				
					

4-4. Service Environment

Item	Main Contents
Storage Environment	• Temperature : $-25 \sim 70^{\circ}\text{C}$ / Humidity : 5 ~ 95% (However, no condensation is allowed)
Operation Environment	• Temperature: $0 \sim 40^{\circ}\text{C}$ / Humidity: 35 ~ 85% (However, no condensation is allowed) • Vibration : Lower than 4~150 Hz, 4.9m/s^2
Power	• Input voltage : $\text{DC } 24\text{V} \pm 10\%$ • Current Consumption : 100mA or less @ 24V
Case material	• Polycarbonate
Size (W×H×D)	• PARALLEL TYPE : $50 \times 66 \times 20\text{mm}$ • Mini PARALLEL TYPE : $50 \times 53 \times 20\text{mm}$
Weight	• Approx. 300g (for EQ, Standard length of I/O cable 1.5m/2.5m)
HPIO Installation place	 ※ <i>Refer to the installation manual for the details</i> HPIO(Master) ANT. 3.5M Communication distance : Within 3.5M HPIO(Slave) ※ Fixing method • PIS fastening : 2 Holes • Adhesive type fastening Fixing Hole position : between 5Cm ~ 8Cm (recommended) *) However, it needs to be installed in the manner to avoid the contact with the returning objects while moving the product

5. CABLE SPECIFICATION

Function	DSUB 25 Pin Number	Color	Function	DSUB 25 Pin Number	Color
IN 1	1	Red 1	Out 1	14	Blue 1
IN 2	2	Red 2	Out 2	15	Blue 2
IN 3	3	Red 3	Out 3	16	Blue 3
IN 4	4	Red 4	Out 4	17	Blue 4
IN 5	5	Green 1	Out 5	18	White 1
IN 6	6	Green 2	Out 6	19	White 2
IN 7	7	Green 3	Out 7	20	White 3
IN 8	8	Green 4	Out 8	21	Black 1
NC	9	–	NC	22	–
SELECT ^{Note 1)}	10	NC	+VIN	23	Red
MODE ^{Note 2)}	11 (GND)	NC	GND	24	Black
Go (Ready)	12	Black 2	GND	25	White
NC (No Connection)	13	–	–	–	–
Serial Connector (DSUB 9P, Female)			TxD	2	Black
			RxD	3	Brwon
			GND	5	Red
Cable connection diagram			DSUB 25P, Male		



Note 1) SELECT: Wires do not need to be connected except control purpose

Note 2) MODE SIGNAL: Wires do not need to be connected as they cannot be controlled from outside.

***] Input / Output signal: This is based on the requirements of semi-E84 standard specification. Please contact us for the other types of connectors.**

Functions of main pins

Signal	Using Method
Mode (Input)	❖ Input to select HPIO mode ✓ GND Connection: Slave Mode ✓ Open: Master Mode (OHT) *.) Nothing needs to be connected from outside as it is connected to GND inside of HPIO
Select (Input)	• Input to operate the Wireless / Optical communication of HPIO ✓ GND connection: It stops the Wireless / Optical communication function ✓ Open : It activates the Wireless/Optical communication function. *.) Nothing needs to be connected from outside except control purpose
GO (Output)	• Output when Wireless / Optical communication between HPIO Master and Slave is normal

8. RELATIONS BETWEEN CHANNELS AND FREQUENCY (5GHz BAND)

CH (Channel)	Frequency (MHz)	WLAN Channel		CH (Channel)	Frequency (MHz)	WLAN Channel		CH (Channel)	Frequency (MHz)	WLAN Channel
128	5725			168	5765	153		208	5805	161
129	5726			169	5766			209	5806	
130	5727			170	5767			210	5807	
131	5728			171	5768			211	5808	
132	5729			172	5769			212	5809	
133	5730			173	5770			213	5810	
134	5731			174	5771			214	5811	
135	5732			175	5772			215	5812	
136	5733			176	5773			216	5813	
137	5734			177	5774			217	5814	
138	5735	149	178	5775	157		218	5815	165	
139	5736		179	5776			219	5816		
140	5737		180	5777			220	5817		
141	5738		181	5778			221	5818		
142	5739		182	5779			222	5819		
143	5740		183	5780			223	5820		
144	5741		184	5781			224	5821		
145	5742		185	5782			225	5822		
146	5743		186	5783			226	5823		
147	5744		187	5784			227	5824		
148	5745		188	5785			228	5825		
149	5746		189	5786			229	5826		
150	5747		190	5787			230	5827		
151	5748		191	5788			231	5828		
152	5749		192	5789			232	5829		
153	5750		193	5790			233	5930		
154	5751		194	5791			234	5831		
155	5752		195	5792			235	5832		
156	5753		196	5793			236	5833		
157	5754		197	5794			237	5834		
158	5755	153	198	5795	161		238	5835		
159	5756		199	5796			239	5836		
160	5757		200	5797			240	5837		
161	5758		201	5798			241	5838		
162	5759		202	5799			242	5839		
163	5760		203	5800			243	5840		
164	5761		204	5801			244	5841		
165	5762		205	5802			245	5842		
166	5763		206	5803			246	5843		
167	5764		207	5804			247	5844		
*) Highlighted cells need to check the availability of use by each country. Please contact us when this band needs to be used. *) In order to use this product stably, please set the channel in the manner to avoid the interference with the other devices such as wireless LAN or Bluetooth.							248	5845		
							249	5846		
							250	5847		
							251	5848		
							252	5849		
							253	5850		
							254	5851		
							255	5852		

9. RELATIONS BETWEEN CHANNELS AND FREQUENCY (2.4GHz BAND)

CH (Channel)	Frequency (MHz)	WLAN Channel					CH (Channel)	Frequency (MHz)	WLAN Channel				
0	2400						44	2444					
1	2401						45	2445					
2	2402						46	2446					
3	2403						47	2447					
4	2404						48	2448					
5	2405						49	2449					
6	2406						50	2450					
7	2407						51	2451					
8	2408						52	2452					
9	2409						53	2453					
10	2410						54	2454					
11	2411						55	2455					
12	2412						56	2456					
13	2413						57	2457					
14	2414						58	2458					
15	2415						59	2459					
16	2416						60	2460					
17	2417						61	2461					
18	2418						62	2462					
19	2419						63	2463					
20	2420						64	2464					
21	2421						65	2465					
22	2422						66	2466					
23	2423						67	2467					
24	2424						68	2468					
25	2425						69	2469					
26	2426						70	2470					
27	2427						71	2471					
28	2428						72	2472					
29	2429						73	2473					
30	2430						74	2474					
31	2431						75	2475					
32	2432						76	2476					
33	2433						77	2477					
34	2434						78	2478					
35	2435						79	2479					
36	2436						80	2480					
37	2437						81	2481					
38	2438						82	2482					
39	2439						83	2483					
40	2440						84	2484					
41	2441						...	...					
42	2442						95	2495					
43	2443						125	2525					

*) Highlighted cells
need to check the
availability of use
by each country.
Please contact us
when this band
needs to be used.

FCC Statement

FCC Part 15.19

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Part 15.21

Any changes or modifications (including the antennas) to this device that are not expressly approved by the manufacturer may void the user's authority to operate the equipment.

FCC RF Radiation Exposure Statement

This equipment complies with FCC RF Radiation exposure limits set forth for an uncontrolled environment. This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.