

# ez-Caster EN3 (Encoder/ATSC Modulator)

MPEG2/H.264 HD Encoder (for IP/ATSC/8VSB)





# EN3 - Encoder + Modulator Manual

Revision Number: 1.0.1 Distribution Date: August. 2016

#### **Copy Rights**

Copyright © 2016 LUMANTEK Co., Ltd. All Rights Reserved

This document contains information that is proprietary to LUMANTEK.CO., LTD. The information in this document is believed to be accurate and reliable; however, LUMANTEK assumes no responsibility or liability for any errors or inaccuracies that may appear in this document, nor for any infringements of patents or other rights to third parties resulting from its use.

This publication may contain technical issues, inaccurate information or typos. These will be revised in revised edition, if there is any. No part of this publication is subject to be reproduced, stored in retrieval system, or transmitted in any forms, or any means without the prior consent by Lumantek.

#### Trademarks

HD ENCODULATOR <sup>™</sup>, SD ENCODULATOR <sup>™</sup> LUMANTEK Logo, Mega Cruiser<sup>™</sup>, ORIX<sup>™</sup>, X-Cruiser<sup>™</sup>, DTA-Plus<sup>™</sup>, Media Blaster<sup>™</sup>, are Trademarks of Lumantek. Co., Ltd.

Any other trademarks than stated above in this document belongs to its pertinent corporation.

#### **Warranty Period**

Lumantek's products comes with One(1) year limited warranty. Please contact below if you need more information.

LUMANTEK CUSTOMER SERVICES

sales@lumantek.co.kr / TEL:02-6947-7421 / FAX:02-6947-7440



# Contents

1.	Introduction	4
2.	Specifications	5
3.	Product Description	6
3.1.	Product Parts Name	6
3.2.	Components	6
3.3.	Installation Precaution	7
4.	Product Operation	8
4.1.	Status LED	8
4.2.	Front Control Panel	9
4.2.3	1. Category Structure Summary	10
4.2.2	2. Setting category Summary	11
4.2.3	3. Location and Operation Description	12
Арр	endix A. PC GUI Control S/W	19
Арр	endix B. Frequency Table	23



### EN3 - Encoder + Modulator

MPEG2/H.264 HD Encoder (for IP/ATSC/8VSB)

#### 1. Introduction

The 'ez-Liveshow' is a new Audio/Video system brand with AV encoding and multiplexing technology from Lumantek designed for small studio applications. EN3 is one of the 'ez-Liveshow' series enabling a simultaneous video/audio encoding technology and modulation in a single device once. Optimized for Korean terrestrial TV environment, supporting Mpeg-2 Video and AC3 Audio technology as well as the 8VSB modulation. System supports HDMI, HD-SDI, Component and Composite inputs with HDMI, HD-SDI, Analog Stereo Audio(L/R) for audio inputs.





# 2. System Specifications

Туре	HD Encoder + 8VSB Modulator				
	SD/HD-SDI, BNC 75Ω 1ea				
	HDMI 1.4a 1ea (HDCP not supported)				
Inputs	Component, YCbCr, 170MHz 12bit ADC, RCA 3ea				
	Composite, CVBS, 3D Comb Filter, RCA 1ea				
	Analog Stereo Audio (Left/Right), RCA 2ea				
	1920x1080 @ 60p, 59.94p Automatic Convert to interlaced format				
	1920x1080 @ 60i, 59.94i				
Video Resolutions	1280x720 @ 60p, 59.94p				
	720x480 @ 59.94i (NTSC)				
	Resolution detect and automatic/manual change support				
	System Delay: 150ms, 200ms, 350ms,650ms				
TS Mux &	TS Bit-rate: 4.5~25 Mbps				
System	Editable TS ID, PMT/PCR/Video/Audio PID				
	MPEG2, H.264				
	MPEG2 HD/SD (MP@HL/MP@ML), H.264 HD/SD (HP@L4/HP@L3)				
Video Encoder	Bit Rate: (MPEG2) 5Mbps ~ 22 Mbps, (H.264) 3.5Mbps ~ 22Mbps				
	Closed Caption Support				
	MP1L2, Dolby AC3, AAC-LC, HE-AACv2 (Stereo)				
	Bit-rate: 192~384 Kbps (HE-AACv2 - 32~96Kbps)				
Audio Encoder	Sample Rate: 48KHz				
	Audio Delay: 0~400ms				
	Volume Control: 100%~500%				
	MGT, TVCT Generation Enable/Disable				
PSIP Generator	Short name, major and minor channel number setting				
	Connector: BNC 75Ω 1ea				
ASI Output	Packet Size: 188 Bytes				
	TS Bit Rate: 19.392Mbps				
	Modulation: ATSC(8VSB)				
	Connector: F-Type 75Ω 1ea				
	Output Level : +2~-18dBm (0.5dB Step)				
RF Output	Center Frequency Range: 40~999 MHz				
	MER: >36dB				
	Spurious: 60dBc (Relative to Output Level)				
	Phase Noise: VHF 110dBc@20kHz, UHF 95dBc@20kHz				
	Ethernet : 10/100Bast-T, half/full duplex				
IP Output	Maximum Transmission Unit : 1464~1472 MTU				
(*Option)	Streaming Protocol : MPEG2-TS/UDP				
	Transport Protocol : UDP, Unicast or Multicast				
	IGMPv1, IGMPv2 support				
Moncross	Front Panel: 4-line text LCD, 6 buttons, Status LED(RGB)				
wanagement	Rear USB Port: GUI, Firmware Update				
	Dimension: 44(H) X 483(W) X 240(D) (excluding connectors)				
Dhusical	Operation Temperature: 0~45℃				
Physical	Weight: 2 Kg				
	Power Consumption: 25W(max.)				

# LUMANTEK®



#### 3. Product Description

#### 3.1. Product Part Name

< EN3 Main frame – Front>



#### 3.2. Components

This system package includes:

- ① EN3 Main Frame
- ② AC Power Cord :110V AC or 220V AC input Power Cord





#### 3.3. Installation Precautions

This page states the safety measures the users must take to avoid circumstances where the system may occur physical damages or injuries. Please THOROUGHLY go over this page before the system installation/operation.

#### **General Precautions**

- Maintain dust FREE condition during and after System Installation/Operation.
- Please place the system cover in a safe location when opened.
- Securely stow tools and cables away from the passages.
- Avoid wearing loosened clothes or accessories during installation/Operation.
- Avoid any unnecessary actions that may damage/harm system or personnel.
- Do NOT open the system unless advised by Lumantek representative. Lumantek takes no responsibility on units with broken RMA seals.

#### **Power Precautions**

- Please check cable overload before connecting the system to the power supply.
- Avoid wearing metal accessories (Rings, Earrings) connecting system to the power source.
- Avoid operating on wet floors. Make sure power extension cables, floors, and instruments are grounded and in a safe operating condition.



- Please discharge static electricity by touching grounding metals before starting hardware installation.
- The grounding parts must be disassembled last.
- Manufacture takes no responsibilities on Direct/Indirect losses or damages due to use of inappropriate parts or services by unauthorized service provider
- Supplying power during the system installation may cause damages to the system and personnel.

#### **AC Power Precautions**

- This unit utilizes AC power, the cord comes with a grounding function.
- Please connect the system to the power socket with groundings.
- Use Green/Yellow 0.75mm2 (18AWG) or higher grade grounding cables.
- Do NOT block power sockets with tools or boxes. Please keep it clear at all times.



#### 4. Product Operation

#### 4.1. Status LED

Status LED- blue, geen and red, total of three colors available. Each color indicates the following status.



- System Booting
- Applying setting value
- Changing resolution



• Normal operation (Data input detected)



- No input
- Resolution not supported
- Internal operation error



#### 4.2. Front Control Panel

Control and configure system settings with LCD screen, Arrow, settings and ESC keys at Front Control Panel





# \*\* Move cursors / Change settings Settings value (Number)

Increase settings value (Number) Setting value (Number) Decrease setting value(Number)

Confirm current setting

Exit menu

## **LUMANTEK**®



#### 4.2.1. Category Structure Summary









#### 4.2.2. Setting Category Summary

Sub Menu Location	Setting Categories	Value, range	Features
	VIDEO IN	CVBS COMPONENT HDMI SDI SDIcc	Select video input port (*when selected, the audio input port is automatically changed to appropriate input port.) (*SDIcc is SDI input mode supporting closed caption)
INPUT	AUDIO IN	RCA HDMI SDI	Select audio input port
	RESOLUTION	AUTO 1080p 1080i 720p 480i	Choose either Automatically detecting the input resolution, or allowing specific resolutions only.
	PATTERN	BLACK WHITE BLUE	Select a color pattern displayed when no input signal detected.
	SYS DELAY	150,200,350,650 (ms)	Encoder delay Configuration
ENC	TS ID	1~65534	TS ID Settings
	AUDIO DELAY	0 ~ 400 (ms)	Audio Delay Settings
	PSIP OUT	ENABLE, DISABLE	PSIP output On/Off
DEID	MAJOR CH	1~99	Major channel Settings
FJIF	MINOR CH	1 ~ 999	Minor channel Settings
	NET NAME	Maximum 7 letters	Channel name Settings
	SET FREQ	40.0 ~ 999.0 MHz	Output frequency Settings - Frequency input
MODULAT	SET FREQ BY KOR-T	2~69	Output frequency Settings - Terrestrial channel number input
UK	SET FREQ BY KOR-C	2~158	Output frequency Settings - Cable channel number input
	POWER	-18.0 ~ +2.0 (dBm)	Output power Settings



Sub Menu Location	Setting Categories	Value, range	Features
	OUT	Enable Disable	IP Output Enable/Disable
	dsi ip address	XXX.XXX.XXX.XXX	Output destination IP address setting
	DST UDP PORT	1 ~ 65535	Output destination UDP port number setting
	HOST IP ADDRESS	XXX.XXX.XXX.XXX	Select Host IP Address
IP-OUT (*option)	HOST SUBNET MASK	XXX.XXX.XXX.XXX	Select Host Subnet Mask
	HOST GATEWAY	XXX.XXX.XXX.XXX	Select Host Gateway Address
	HOST MAC ADDR	XX-XX-XX-XX-XX-XX	Check the MAC Address of the equipment (Modification is not possible)
	ERR#	CLEAR CANCEL	When 'CLEAR' is selected, Output error counter for monitoring will be initialized.
System	LOAD DEFAULT	YES NO	Reset 'Setting values'
	REBOOT	YES NO	Reset



#### 4.2.3. Location and Operation Description



Setting location	<b>◀</b> ,►	▲,▼	SET	ESC	Features
operatio n status	n/a	n/a	Move to main menu	n/a	Display settings and input status



#### 2) Main Menu



Setting location	<b>∢,</b> ►	▲,▼	SET	ESC	Features
Main menu	n/a	Move to category	Move to the sub menu of the selected category	Move to the operatio n status	When you select sub menu from the category, it moves to appropriate sub menu



#### 3) INPUT Menu and Setting Categories

>> INPUT << >VIDEO IN: HDMI AUDIO IN: HDMI RESOLUTION: AUTO	>VIDEO IN: HDMI   CVBS (COMPOSITE)   COMPONENT  > HDMI   SDI   SDIcc
PATTERN: BLUE	>AUDIO IN: HDMI   RCA  > HDMI   SDI
	>RESOLUTION: AUTO   AUTO  > 1080p   1080i   720p   480i
	>PATTERN : BLUE   BLACK   WHITE  > BLUE

Setting location	<b>∢,</b> ►	▲,▼	SET	ESC	Features
INPUT Sub menu	n/a	Move to category	Move to the selected category	Move to main menu	
VIDEO IN	n/a	Move to category	Confirm	Move to sub menu	Select video input port
AUDIO IN	n/a	Move to category	Confirm	Move to sub menu	Select audio input port
RESOLU TION	n/a	Move to category	Confirm	Move to sub menu	Select Resolution mode
PATTER N	n/a	Move to category	Confirm	Move to sub menu	Select a color pattern when input is not detected

\*Video – SDIcc setting is specifically designed mode for Closed Caption service and some features may not be supported. (1080P input resolution and pattern image setting)



#### 4) ENCODER Sub Menu and Setting Categories



Setting location	<b>◀</b> ,►	▲,▼	SET	ESC	Features
ENCODER Sub menu	n/a	Move to category	Move to the selected category	Move to main menu	
SYS DELAY	n/a	Move to category	Confirm	Move to sub menu	Encoder system delay setting. (*License required) (*without license, fixed at 650)
TS ID	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	TS ID Value setting.
AUD DELAY	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Audio Delay Value setting



#### 5) PSIP Sub Menu and Setting Categories



Setting location	◀,►	▲,▼	SET	ESC	Features
PSIP Sub menu	n/a	Move to category	Move to the selected category	Move to main menu	
PSIP OUT	n/a	Move to category	Confirm	Move to sub menu	PSIP output on/off.
MAJOR CH	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Main channel number value setting.
MINOR CH	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Minor channel number value setting.
NET NAME	Move digit	Change letter	Apply settings	Move to sub menu	Channel name setting. (* Korean letter setting is available on PC S/W )



6) MODULATOR Sub Menu and Setting Categories



Setting location	∢,►	▲,▼	SET	ESC	Features
MODULA TOR Sub Menu	n/a	Move to category	Move to the selected category	Move to main menu	
STAT	n/a	n/a	n/a	n/a	Frequency setting mode and displays the currently set value
SET FREQ	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Output frequency setting - Frequency input
SET FREQ BY KOR-T	Move digit	Increase/ decrease the value	Confirm	Move to sub menu	Output frequency setting - Terrestrial channel number input
SET FREQ BY KOR-C	Move digit	Increase/ decrease the value	Confirm	Move to sub menu	Output frequency setting - Cable channel number
POWER	Increase/ decrease the value	Increase/ decrease the value	Apply settings	Move to sub menu	Output power setting



7) IP-OUT Sub Menu & Setting Categories (\*option)



Setting location	◀,►	▲,▼	SET	ESC	Features
IP-OUT Sub menu	n/a	Move to category	Move to the selected category	Move to main menu	
Ουτ	n/a	Change selection	Apply selection	Move to sub menu	IP Output Enable/Disable
DST IP ADDRESS	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Output destination IP address setting
DST UDP PORT	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Output destination UDP port number setting
HOST IP ADDRESS	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Select Host IP Address
HOST SUBNET MASK	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Select Host Subnet Mask
HOST GATE WAY	Move digit	Increase/ decrease the value	Apply settings	Move to sub menu	Select Host Gateway Address
HOST MAC ADDR	n/a	n/a	Move to sub menu	Move to sub menu	Check the MAC Address of the equipment (Modification is not possible)
ERR#	n/a	Change selection	Apply selection	Move to sub menu	When 'CLEAR' is selected, Output error counter for monitoring will be initialized



#### 8) SYSTEM Sub Menu and Setting Categories



Setting location	<b>◀</b> ,►	▲,▼	SET	ESC	Features
SYSTEM Sub menu	n/a	Move to category	Move to the selected category	Move to main menu	
VERSION	n/a	n/a	n/a	n/a	Display device's version
LOAD DEFAULT	n/a	Move to category	Confirm	Move to sub menu	Output power frequency setting - Cable channel number input
RESET	n/a	Move to category	Confirm	Move to sub menu	Output power setting



# Appendix A. PC GUI Control S/W

#### A.1. Connect EN3 with PC GUI S/W

PC GUI S/W is connected via USB Port.



#### A.2. PC GUI S/W Driver installation and verification

When PC and EN3 is connected, make sure that following driver is created PC. (COM number may differ from ours)



(\*if driver is not installed automatically, install CypressDriverinstaller.exe which comes with PC GUI S/W.)



#### A.3. PC GUI S/W Connection and Control

T EN3_Control_App (1v01)	test setting	_ <b>_</b> ×
Refresh       COM3       Come         Get Configs       Run Status Update       5         Setting       Select a COM port       C         Vers       Select a COM port       C         Inp       Device Manager       C	ect to Console	Firmware Update
T EN3_Control_App (1v22)		
Refresh       COM3       Disconr         Get Configs       Run Status Update       5       •         Settings       Version       0x0122       •         Read the value       Ing       Run Status mon Input : RCA         Version       : Auto video Pattern : White         Encoder       System Delay : 200 ms	nect to Console	Firmware Update
PSIP PSIP PSIP PSIP PSIP Output : Enable Major Ch : 04 Minor Ch : 001 Network Name :	Temperature : 47`C License : 0x00000001 Comm. Status	
VSB Output : KOR-T 04 Ch Power : +00.0dBm	GET_DONE Rx Err: 0 / 8	Stack : 0

**LUMANTEK**®





**LUMANTEK**®



#### A.4. PC GUI S/W Firmware Update

Click following button to open firmware update window..

Click	Firmware Update
Click	

Click 'Open' and choose specific file and click 'Download' to start the firmware update.

EN3 Firmwar	e Updator	a. a	<u> </u>		
File Path			Open		Open file
Device Sel	0 •	Download		<b>_</b>	Run update
			Close		

Make sure update is completed by checking the following message.

please wait! reading data! 0x00000000 ~ 0x001E0000 0x001DFF00/0x001E0000 00000000 ~ 001DFFFF verify complete!	^
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	
please waitdevice closing	=
Ok:Device Reset successfull, completed, -End-	
Ok:Device close successfull, completed, -End-	<b>•</b>



# **Appendix B. Frequency Table**

		Korea Terrestrial		Korea Cable		
	Channel Number	Center Frequency (MHz)	Frequency Range (MHz)	Channel Number	Center Frequency (MHz)	Frequency Range (MHz)
	2	57	54-60	2	57	54-60
	3	63	60-66	3	63	60-66
VHF LOW BAND	4	69	66-72	4	69	66-72
	5	79	76-82	5	79	76-82
	6	85	82-88	6	85	82-88
				95	93	90~96
				96	99	96~102
00~10010172			Center guency (MHz)         Frequency (MHz)         Channel Number (MHz)         Center Frequency (MI           57         54-60         2         57           63         60-66         3         63           69         66-72         4         69           79         76-82         5         79           85         82-88         6         85           96         97         96         99           97         705         93         93           96         99         91         70         105           97         98         111         98         111           98         111         129         117           14         123         129         117           14         123         129         117           16         135         129         117           17         141         123         129           16         135         129         129           17         141         121         165           17         141         121         165           18         180-186         8         183	105	102~108	
				98	111	108~114
				99	117	114~120
				14	123	120-126
				15	129	126-132
				16	135	132-138
MID BAND				17	141	138-144
				18	147	144-150
				19	153	150-156
				20	159	156-162
				21	165	162-168
				22	171	168-174
	7	177	174-180	7	177	174-180
	8	183	180-186	8	183	180-186
	9	189	186-192	9	189	186-192
vhf high band	10	195	192-198	10	195	192-198
	11	201	198-204	11	201	198-204
	12	207	204-210	12	207	204-210
	13	213	210-216	13	213	210-216
				23	219	216-222
				24	225	222-228
				25	231	228-234
				26	237	234-240
				27	243	240-246
				28	249	246-252
				29	255	252-258
SUPER BAND				30	261	258-264
				31	267	264-270
				32	273	270-276
				33	279	276-282
				34	285	282-288
				35	291	288-294
				36	297	294-300



HYPER BAND         Image: Solution of the second secon		Korea Terrestrial			Korea Cable		
HYPER BAND         38         309         306-312         318-324           HYPER BAND         40         321         318-324         338-324           HYPER BAND         41         327         324-330         330-336           HYPER BAND         42         333         330-336         342-348           HYPER BAND         44         345         342-348         342-348           HYPER BAND         90         375         372-378         346-372           HYPER BAND         90         375         372-378         346-372           HYPER BAND         90         375         372-378         346-372           HYPER BAND         90         905-602         331         378-384           HYPER BAND         90         905-602         331         378-384           HYPER BAND         90         905-602         331         378-384           HYPER BAND         90         935         432-438         342-448           HYPER BAND         90         935         432-438         340-346           HYPER BAND         90         936         432-448         444-444         444-444         444-444         444-444         444-444         444-444 <td rowspan="6"></td> <td></td> <td></td> <td></td> <td>37</td> <td>303</td> <td>300-306</td>					37	303	300-306
HYPER BAND         33         315         312-318           HYPER BAND         41         327         334-330           HYPER BAND         43         339         336-342           HYPER BAND         43         339         336-342           HYPER BAND         44         335         342-338           HYPER BAND         46         357         354-342           HYPER BAND         90         47         363         390-336           HYPER BAND         50         381         372-378           HYPER BAND         51         3807         384-390           HYPER BAND         51         3807         384-390           HYPER BAND         51         3807         384-390           HYPER BAND         52         303         399         396-406           HYPER BAND         52         303         399         396-406           HYPER BAND         52         303         399         396-406           HYPER BAND         53         411         408-444         405         405         402-468           HYPER BAND         53         411         408-444         405         405         402-468         406					38	309	306-312
HYPER BAND         40         321         338-324           HYPER BAND         42         333         36-342           HYPER BAND         44         345         342-348           HYPER BAND         44         345         342-348           HYPER BAND         46         357         354-360           HYPER BAND         47         363         360-372           HYPER BAND         51         348-354         372-378           HYPER BAND         51         387         384-390           HYPER BAND         53         399         390-396           HYPER BAND         53         387         384-390           HYPER BAND         53         399         390-396           HYPER BAND         53         399         390-396           HYPER BAND         55         411         408-414           HYPER BAND         56         477         414-420           HYPER BAND         56         477         444-420 <tr< td=""><td></td><td></td><td></td><td>39</td><td>315</td><td>312-318</td></tr<>					39	315	312-318
HYPER BAND         1         127         324-330           HYPER BAND         42         333         330-336           HYPER BAND         43         339         336-342           HYPER BAND         45         351         348-354           HYPER BAND         46         357         354-360           HYPER BAND         47         363         360-366           1         1         1         372-378           1         1         1         373-336           1         1         1         373-336           1         1         1         372-378           1         1         1         373-336           1         1         1         373-336           1         1         1         333-330-336           1         1         1         333-336           1         1         1         333-336           1         1         1         333-336           1         1         1         333-336           1         1         1         333-336           1         1         1         333-336           1         1					40	321	318-324
HYPER BAND         Image: space sp					41	327	324-330
HYPER BAND         Image: space sp					42	333	330-336
HYPER BAND         Image: space sp					43	339	336-342
HYPER BAND         45         351         348-354           HYPER BAND         46         357         353-360           1         47         363         360-362           1         48         369         366-372           1         48         369         366-372           1         50         381         378-384           1         50         381         378-384           1         51         387         384-390           1         52         393         390-396           1         55         411         408-414           1         55         411         408-414           1         56         417         414-420           1         56         417         414-420           1         60         441         438-444           1         61         444         426-432           1         62         453         450-456           1         64         465         462-466           1         64         465         462-466           1         67         483         480-486           15         479					44	345	342-348
HYPER BAND         Image: constraint of the second sec					45	351	348-354
HYPER BAND         Image: square					46	357	354-360
HYPER BAND         1         48         369         366-372           HYPER BAND         51         381         372-378         381         372-378           Image: Construct of the state					47	363	360-366
HYPER BAND         Image: space sp					48	369	366-372
HYPER BAND         S0         381         378-384           Image: Solid State S					49	375	372-378
HYPER BAND         Image: square					50	381	378-384
UHF BAND         S2         393         300-396           Image: Signal S	HYPER BAND				51	387	384-390
Image: Construction of the system o					52	393	390-396
Image: Construct of the system of t					53	399	396-402
Image: Construct of the system of t					54	405	402-408
Image: Construct of the system of t					55	411	408-414
UHF BAND         S00         123         1420-426           1         57         423         420-426           1         58         429         426-432           1         60         441         438-444           1         61         447         444-450           62         453         450-456         450-456           1         62         453         450-456           1         61         447         444-450           1         62         453         450-456           1         61         447         444-450           1         61         447         444-450           1         61         477         474-480           14         473         470-476         66         477           15         479         476-482         67         483         480-486           16         485         482-488         68         489         486-492           17         491         493-500         70         501         498-504           19         503         500-512         72         513         510-516           20         509					56	417	414-420
UHF BAND         Si         723         724         726           UHF BAND         59         435         432-438           UHF BAND         60         441         438-444           0         61         447         444-450           0         61         447         444-450           0         62         453         450-455           0         63         459         456-462           0         64         465         462-468           14         473         470-476         66         477           14         473         470-476         66         477           14         473         470-476         66         477           14         473         470-476         66         477           14         473         470-476         66         477           14         488         68         489         486-492           16         485         482-488         68         489         486-492           19         503         500-506         71         507         504-504           20         509         506-512         72         513					57	423	420-426
UHF BAND         30         100					58	429	426-432
UHF BAND         32         73         741         438-444           1         60         441         438-444         444-450           1         61         447         444-450           62         453         450-452           63         459         456-462           64         465         462-468           65         471         468-474           14         473         470-476         66           15         479         476-482         67         483           16         485         482-488         68         489         486-492           17         491         488-494         69         495         492-498           18         497         494-500         70         501         498-504           19         503         500-506         71         507         504-510           20         509         506-512         72         513         510-516           21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           23         527					50	435	432-438
Image: Construct of the system of t					60	433	432-430
Image: Construct of the system of t					61	441	430-444
Image: Construction of the system o					62	447	450-456
UHF BAND         0.0         4.3.9         4.0.402           UHF BAND         64         465         462-468           14         473         470-476         66         477         474-480           15         479         476-482         67         483         480-486           16         485         482-488         68         489         486-492           17         491         488-494         69         495         492-498           18         497         494-500         70         501         498-504           19         503         500-506         71         507         504-510           20         509         506-512         72         513         510-516           21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546 <tr< td=""><td></td><td></td><td></td><td></td><td>63</td><td>455</td><td>456 462</td></tr<>					63	455	456 462
Image: Construct of the system of t					64	459	430-402
Initial         Initial <t< td=""><td></td><td></td><td></td><td></td><td>65</td><td>405</td><td>402-400</td></t<>					65	405	402-400
I4         I73         I70-476         66         I77         I474-440           15         I79         I76-482         67         I83         480-486           16         I85         482-488         68         I89         486-492           17         I91         488-494         69         I95         I92-498           18         I97         494-500         70         S01         498-504           19         S03         500-506         71         S07         I54-510           20         S09         S06-512         72         I33         I510-516           21         S15         S12-518         73         S19         S16-522           22         S21         S18-524         74         S25         S22-528           23         S27         S24-530         75         S31         S28-534           24         S33         S30-536         76         S37         S34-540           25         S39         S36-542         77         S43         S40-552           27         S51         S48-564         79         S55         S52-558           28         S57         S54-560		14	472	170 176	66	4/1	400-474
Ib         Ib<         Ib<         Ib<         Ib<         Ib<         Ib<         Ib<         Ib<         Ib<         Ib< <thib< th=""> <thib<< th=""> <thib<< th=""></thib<<></thib<<></thib<>		14	4/3	4/0-4/0	67	4//	4/4-400
Ind         Ind <td></td> <td>15</td> <td>4/9</td> <td>4/0-402</td> <td>69</td> <td>403</td> <td>400-400</td>		15	4/9	4/0-402	69	403	400-400
In         491         486-494         69         493         492-496           18         497         494-500         70         501         498-504           19         503         500-506         71         507         504-510           20         509         506-512         72         513         510-516           21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         582-582           31         575         572-578		10	465	402-400	60	489	400-492
18         497         494-300         70         501         498-304           19         503         500-506         71         507         504-510           20         509         506-512         72         513         510-516           21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           24         533         530-536         76         531         534-540           25         539         536-542         77         543         540-546           26         545         542-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590		1/	491	488-494	69	495	492-498
UHF BAND         19         503         500-506         71         507         504-510           20         509         506-512         72         513         510-516           21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581		18	497	494-500	70	501	498-504
20         309         500-512         72         513         510-516           21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590		19	503	500-506	/1	507	504-510
21         515         512-518         73         519         516-522           22         521         518-524         74         525         522-528           23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596		20	509	506-512	72	513	510-516
22         521         518-524         74         525         522-528           23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603		21	515	512-518	73	519	516-522
23         527         524-530         75         531         528-534           24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         602-608         88		22	521	518-524	74	525	522-528
24         533         530-536         76         537         534-540           25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614		23	527	524-530	75	531	528-534
25         539         536-542         77         543         540-546           26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620		24	533	530-536	/6	53/	534-540
26         545         542-548         78         549         546-552           27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626		25	539	536-542	//	543	540-546
27         551         548-554         79         555         552-558           28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632		26	545	542-548	/8	549	546-552
28         557         554-560         80         561         558-564           29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638		2/	551	548-554	/9	555	552-558
UHF BAND         29         563         560-566         81         567         564-570           30         569         566-572         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641		28	557	554-560	80	561	558-564
30         569         566-5/2         82         573         570-576           31         575         572-578         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650	UHF BAND	29	563	560-566	81	567	564-570
31         5/5         5/2-5/8         83         579         576-582           32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656		30	569	566-572	82	573	5/0-576
32         581         578-584         84         585         582-88           33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660 <td></td> <td>31</td> <td>575</td> <td>5/2-5/8</td> <td>83</td> <td>579</td> <td>5/6-582</td>		31	575	5/2-5/8	83	579	5/6-582
33         587         584-590         85         591         588-594           34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		32	581	5/8-584	84	585	582-88
34         593         590-596         86         597         594-600           35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		33	587	584-590	85	591	588-594
35         599         596-603         87         603         600-606           36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		34	593	590-596	86	597	594-600
36         605         602-608         88         609         606-612           37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		35	599	596-603	87	603	600-606
37         611         608-614         89         615         612-618           38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		36	605	602-608	88	609	606-612
38         617         614-620         90         621         618-624           39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		37	611	608-614	89	615	612-618
39         623         620-626         91         627         624-630           40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		38	617	614-620	90	621	618-624
40         629         626-632         92         633         630-636           41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		39	623	620-626	91	627	624-630
41         635         632-638         93         639         636-642           42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		40	629	626-632	92	633	630-636
42         641         638-644         94         645         642-648           43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		41	635	632-638	93	639	636-642
43         647         644-650         100         651         648-654           44         653         650-656         101         657         654-660		42	641	638-644	94	645	642-648
44         653         650-656         101         657         654-660		43	647	644-650	100	651	648-654
		44	653	650-656	101	657	654-660

**LUMANTEK**®



	Korea Terrestrial			Korea Cable		
	45	659	656-662	102	663	660-666
	46	665	662-668	103	669	666-672
	47	671	668-674	104	675	672-678
	48	677	674-680	105	681	678-684
	49	683	680-686	106	687	684-690
	50	689	686-692	107	693	690-696
	51	695	692-698	108	699	696-702
	52	701	698-704	109	705	702-708
	53	707	704-710	110	711	708-714
	54	713	710-716	111	717	714-720
	55	719	716-722	112	723	720-726
	56	725	722-728	113	729	726-732
	57	723	728-734	113	725	732-738
	58	731	720 734	115	733	738-744
	50	7/2	74-740	115	741	744 750
	59	743	740-740	110	747	744-730
	61	749	752 750	110	755	756 762
	10	755	/ 52-/ 50	110	759	/ 30-/02
	62	/61	/58-/64	119	/65	/62-/68
	63	/6/	/64-//0	120	//1	/68-//4
	64	//3	//0-//6	121	///	//4-/80
	65	779	//6-/82	122	783	/80-/86
	66	785	782-788	123	789	786-792
	67	791	788-794	124	795	792-798
	68	797	794-800	125	801	798-804
	69	803	800-806	126	807	804-810
				127	813	810-816
				128	819	816-822
				129	825	822-828
UHF BAND				130	831	828-834
				131	837	834-840
				132	843	840-846
				133	849	846-852
				134	855	852-858
				135	861	858-864
				136	867	864-870
				137	873	870-876
				138	879	876-882
				139	885	882-888
				140	891	888-894
				141	897	894-900
				142	903	900-906
				143	909	906-912
				144	915	912-918
				145	921	918-924
				146	927	924-930
				147	933	930-936
				148	939	936-942
				149	945	942-948
				150	951	948-954
				151	957	954-960
				152	963	960-966
				153	969	966-972
				154	975	972-978
				155	981	978-984
				156	987	984-990
				157	993	990-996
				158	999	996-1002
						222 TOOL