

ICS Repeater for Verizon Wireless

Equipment Manual

(IRES-700 10W)

Fujitsu Network Solutions Ltd.

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1 Introduction

The ICS (Interference Cancelling System) repeater has been designed to meet the needs of Network Operators wanting to maximize operational performance while enjoying the cost saving benefits of an effective, integrated, Repeater and eNodeB strategy.

The ICS repeater improves signal quality by eliminating problems such as weak and unstable receive and transmit signals. Customers will enjoy better signal quality, easier access and more stable links.

Using innovative interference cancelling technology, antenna isolation can be improved between 20dB (depending on model) when multi-path feedback signals are present.

Following figure describes ICS repeater system configuration.

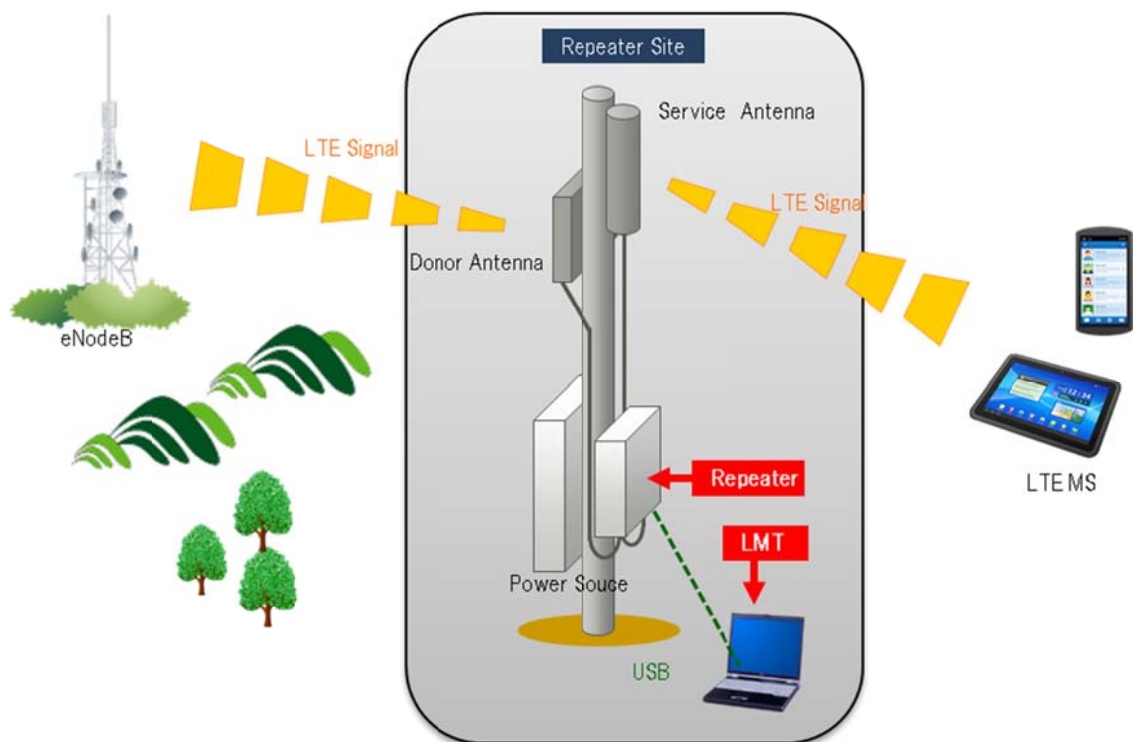


Figure 1 System Configuration

2 Material List

The following table describes material list of ICS repeater.

Table 1 Material List

Item	Pcs	Remarks
ICS Repeater	1	
Repeater Bracket	1	Include Bolts(12 pcs)
Connector for External Alarm	1	5P Waterproofing
LMT Software	—	(CD-ROM)
USB Driver for LMT Software	—	(CD-ROM)
Connector for DC power cable	—	

3 Functional Description

3.1 Block Diagram

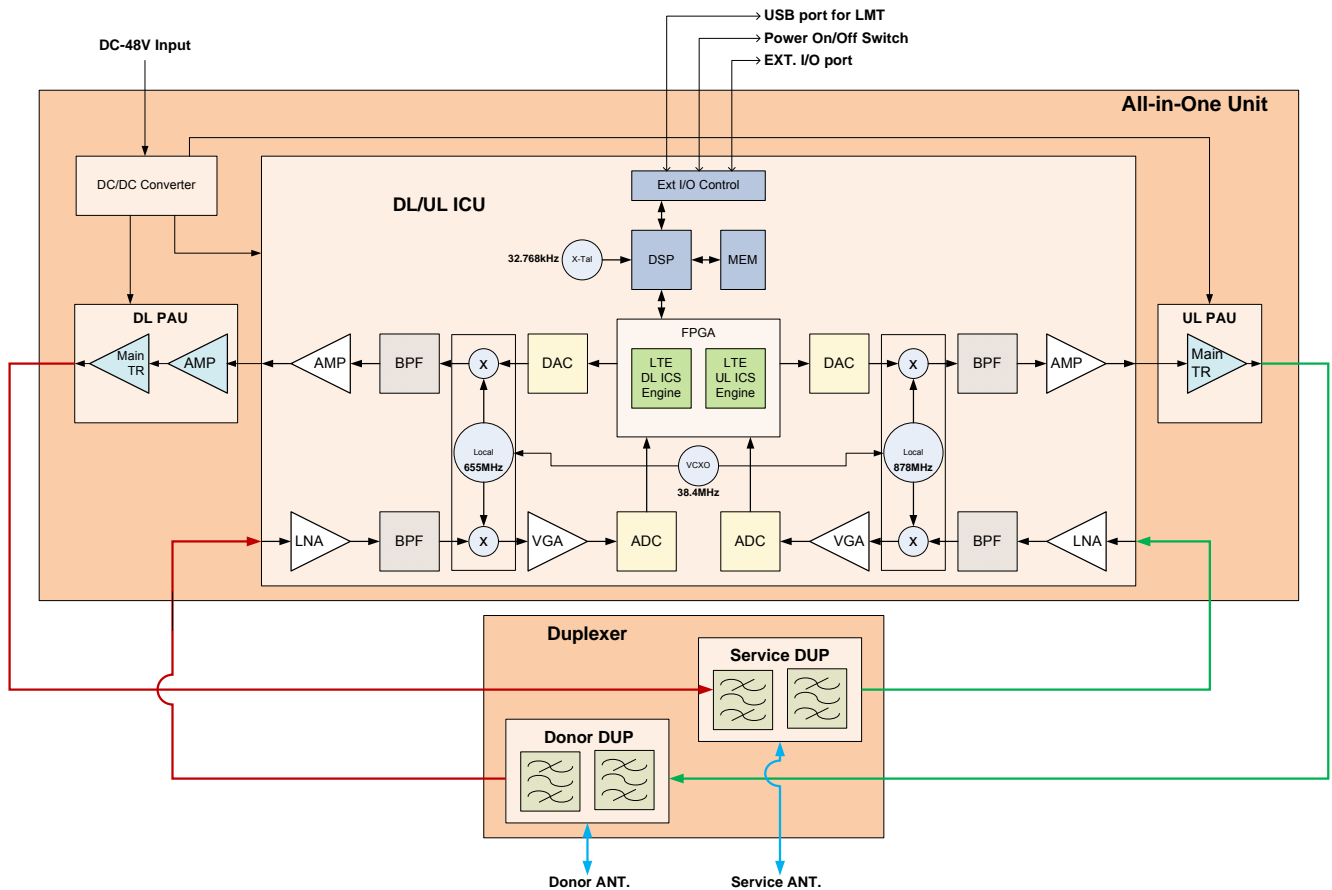


Figure 2 Block Diagram

4 System Specifications

4.1 Mechanical Specifications

Table 2 Mechanical Specifications

Parameter		Specification
Dimensions	Width	342 [mm] \pm 2 [mm] (Without protrusion)
	Depth	165 [mm] \pm 3 [mm] (Without bracket)
	Heights	435 [mm] \pm 2 [mm] (Without protrusion)
Wight (without brancket)		Under 20 [kg]
Power Source	Input Voltage	DC-48 [V] \pm 15[%]
	Power Consumption	Less than 150 [W]

4.2 Electrical Specifications

Table 3 Electrical Specifications

Parameter	Downlink	Uplink	Remarks
Frequency	746[MHz] ~ 757[MHz] Center Frequency : 751MHz (EARFCN : 5230)	776[MHz] ~ 787[MHz] Center Frequency : 782MHz (EARFCN : 23230)	
Carrier	1 Carrier (10 [MHz])		
Max. Output Power	10 [W] (+40 [dBm])	500 [mW] (+27 [dBm])	
Input Power Range	-80[dBm]/Total ~ -20[dBm]/Total	-33[dBm]/Total	
Max. Gain	100[dB]	100[dB]	
Gain Range	40[dB] (60 ~ 100 [dB])	40[dB] (60 ~ 100 [dB])	
Gain Control Step °	1 [dB] Step		
EVM	8[%] or less		3GPP TS 36.106
Max. Input Power	-20 [dBm]	-29 [dBm]	
V.S.W.R	Less than 1.5		
RF Impedance	50 [Ω]		

Parameter	Downlink	Uplink	Remarks
System Delay	Min. 4.0 [μ s]		
Noise Figure	Less than 15 [dB] (in 25°C)	Less than 5 [dB] (in 25°C)	@ maximum gain
Cancel Window size	8.0 [μ s]		
Static Feedback Cancellation Capacity	Max. : -20 [dB] (Direct Feedback)		

4.3 Environmental Specifications

Table 4 Environmental Specifications

Parameter			Specification
Temperature and Humidity. ※No Condensation	Operational	Temperature	-20 [°C] ~ +50 [°C]
		Humidity	5 [%] ~ 95 [%RH]
	Storage	Temperature	-30 [°C] ~ +60 [°C]
		Humidity	5 [%] ~ 95 [%RH]
Cooling system			Natural air cooling
Ingress Protection			IP56

5 System Description

5.1 Equipment Outline

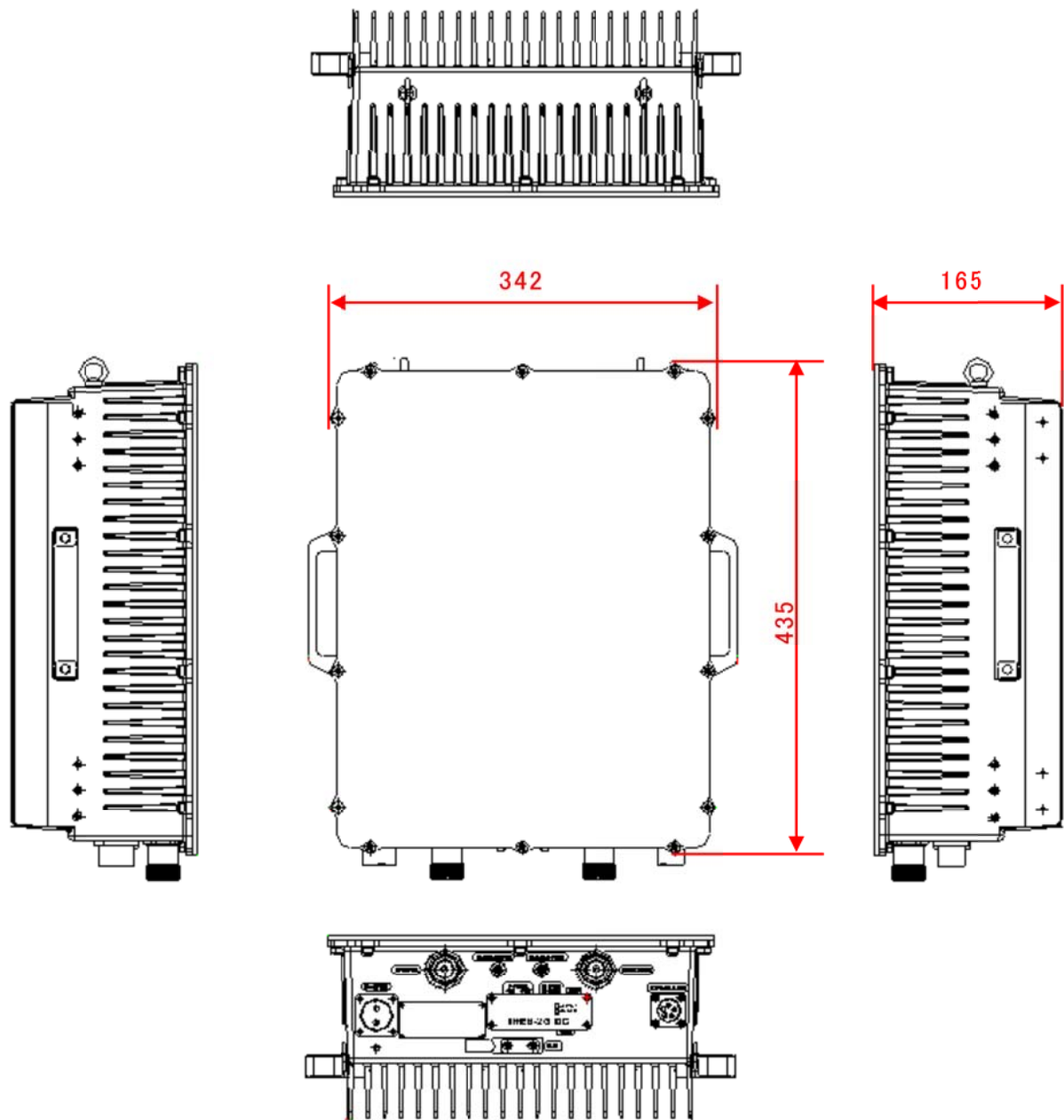


Figure 3 Equipment Outline

5.2 Repeater Bracket Outline

The following figure shows repeater bracket.

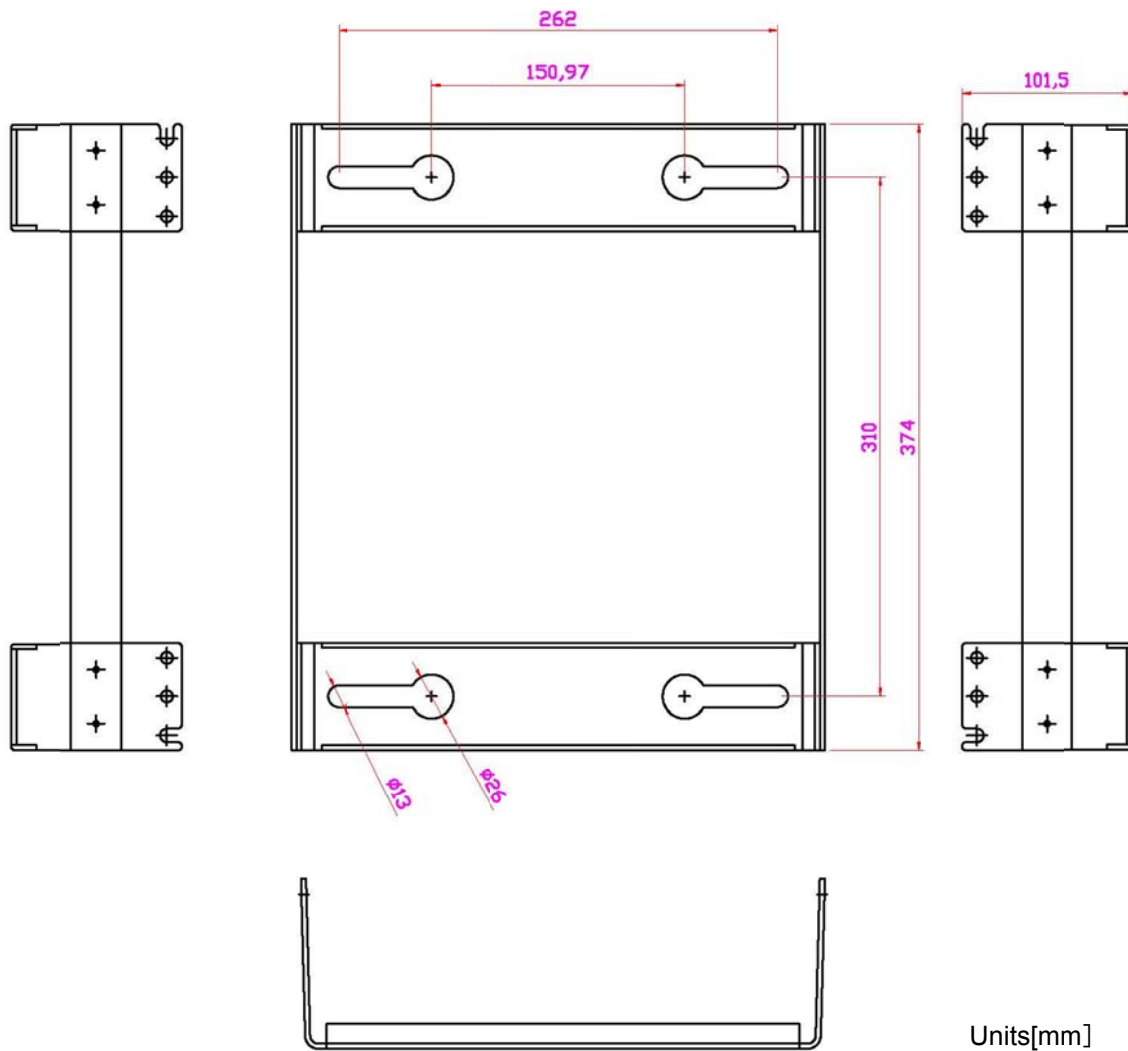


Figure 4 Repeater Bracket Outline

5.3 Interfaces

5.3.1 Interface Description

Table 5 Interfaces

No.	Interface	Port	Remarks
1	Donor Antenna Port	DIN7/16(J)	TRX
2	Service Antenna Port	DIN7/16(J)	TRX
3	DC Power Port	Waterproof 5P Connector	DC-48V (See)
4	External Alarm Port	Waterproof 5P Connector	(See)
5	Monitor Port of Donor Antenna Port	SMA(J)	Coupling Loss: 20dB±2dB
6	Monitor Port of Service Antenna Port	SMA(J)	Coupling Loss: 40dB±2dB
7	Power Switch	—	
8	LMT port	USB (B Type)	PC's Port: USB(A type)
9	LED Indication	LED	PWR ALARM

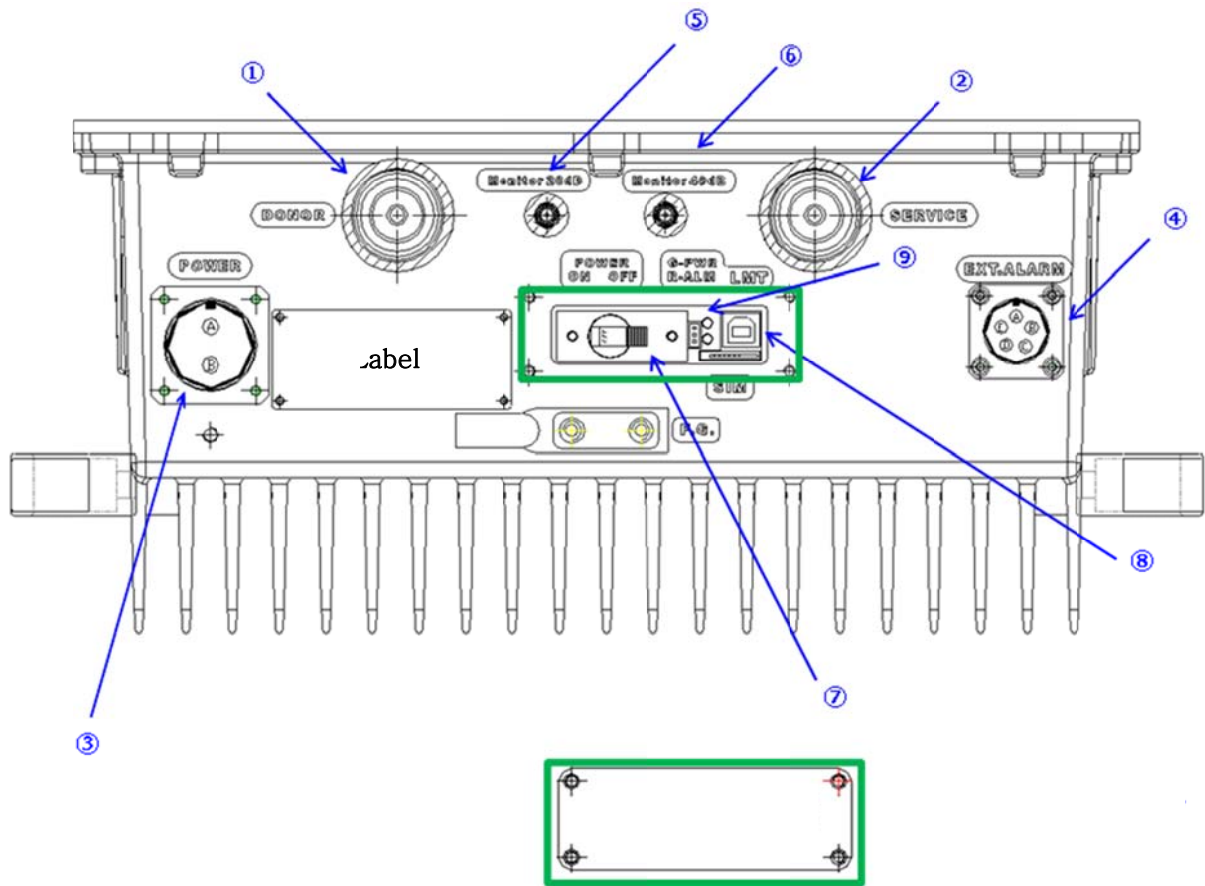
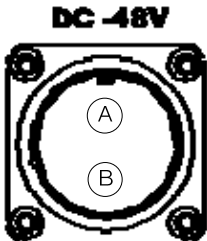


Figure 5 Interfaces Description

5.3.2 Connector Description

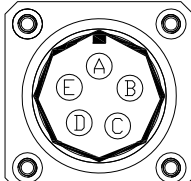
(1) DC Power Port

Table 3 DC Power Port

Connector (Repeater Side)	Pin Assign	
	A	-48V DC INPUT
	B	GND

(2) External Alarm Port Connector

Table 6 External Alarm Connector

Connector (Repeater Side)	Pin Assign	
	A	Ext. Alarm #1
	B	Ext. Alarm #2
	C	Ext. Alarm #3
	D	Ext. Alarm #4
	E	GND (COM)

6 Functions

6.1 ICS Function

The ICS repeater possesses ICS function which can predict and cancel the feedback signal between donor and service antenna.

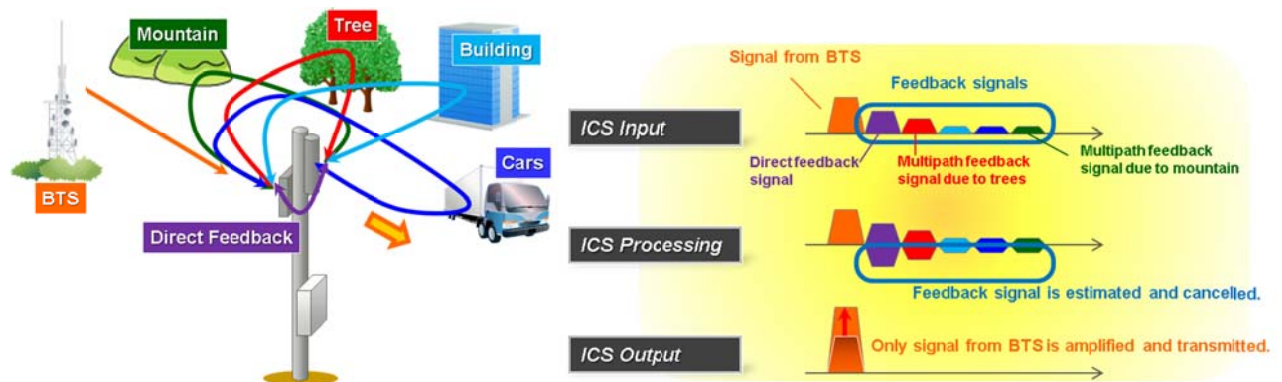


Figure 6 ICS Function

6.1.1 Pilot AGC Function

The repeater has Pilot AGC (Auto Gain Control) function which detect reference signal from eNodeB and control gain to stabilize pilot output power. may not change by change of input power.

Pilot AGC function reference signal from e-Node B in LTE, uses RS (Reference Signal)

Following figure shows Pilot AGC image

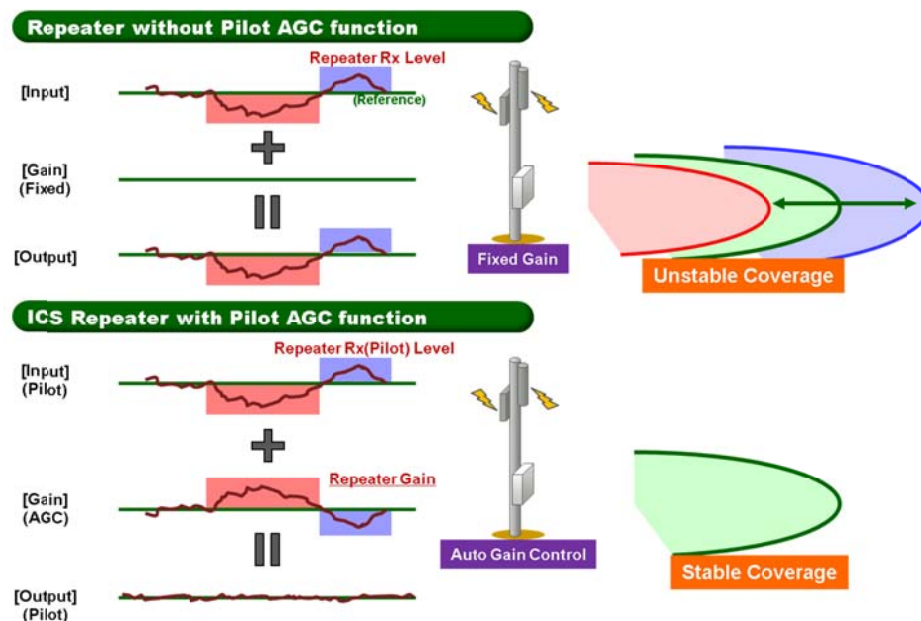


Figure 7 Pilot AGC Image

6.1.2 ALC/AUTO Shutdown/Excessive Input Protection

The repeater has ALC (Automatic Level Control) function. If specified input level is exceeded, the automatic control of the attenuator in equipment is carried out, and an output level is kept constant. Even if it exceeds a maximum input level, repeater is keeping ALC by "Excessive Input protection" function while excessive input protection range

Excessive input protection range is provided keeping maximum output power and avoid immediate shutdown by excessive input. When the repeater detects input which exceeds excessive input protection range, auto shutdown is carried out immediately.

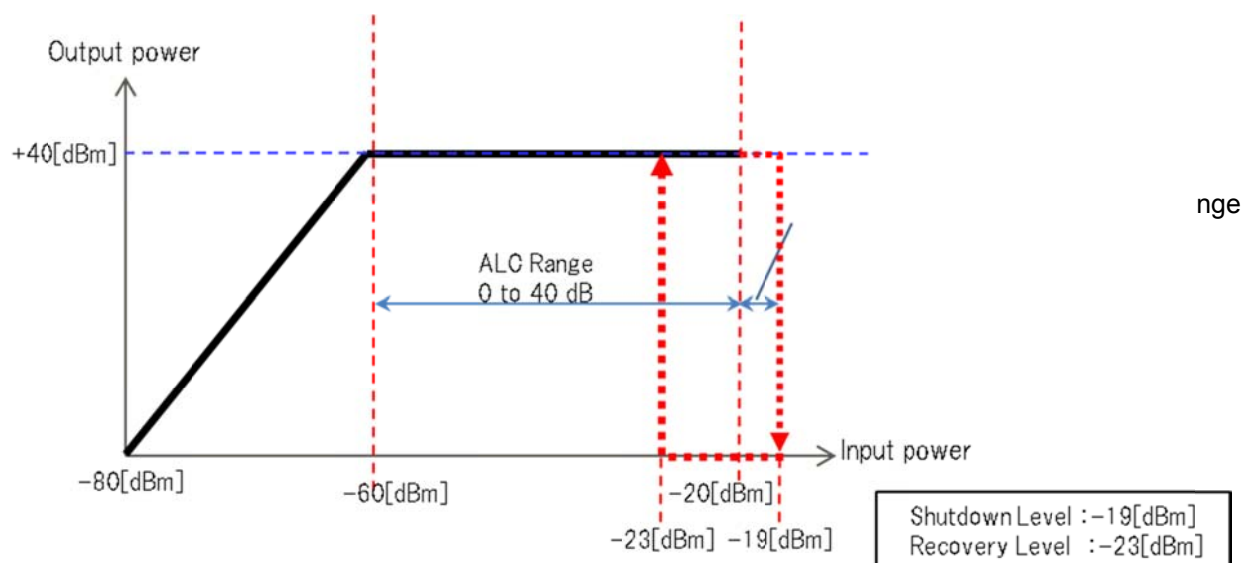


Figure 8 DL ALC/Auto Shutdown/Excessive Input Protection Image @gain 100dB

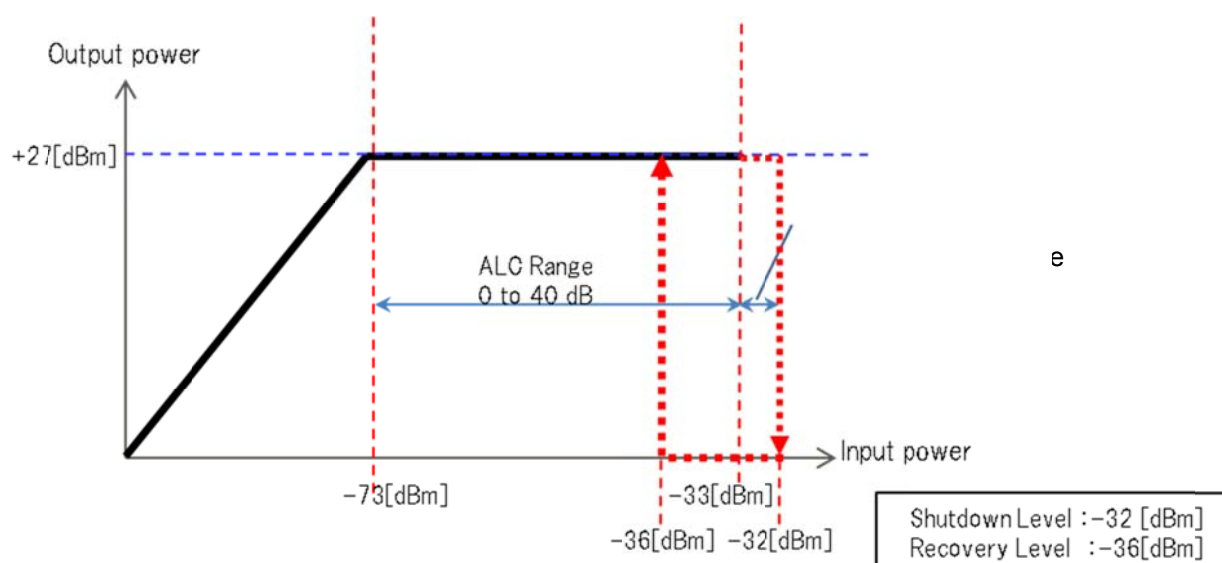


Figure 9 UL ALC/Auto Shutdown/Excessive Input Protection Image @gain 100dB

6.2 Monitor and Control Function

The repeater can be monitored and controlled by LMT (Local Maintenance Terminal). LMT is based on Windows software (Windows XP/VISTA/7) and LMT is connected to the repeater by USB cable. Items of Monitor, control and alarm are shown in the Appendix C.

6.3 External Alarm Indication Function

The repeater has contact interface for external alarm and status can be monitored by LMT. Connector description and pin assignment are shown in table 5.

7 Reference Document

1. 3GPP Specifications

- 3GPP TS36.106 「E-UTRA FDD repeater radio transmission and reception」

2. FCC Specifications

- FCC Title 47 Part27

3. UL Specifications

- UL 60950-1
- UL 60950-22

Appendix A: Spurious emissions limits

Table 7 Spurious emissions limits

(Spurious emissions limits for E-UTRA-FDD repeater in geographic coverage area of systems operating in other frequency bands)

System type operating in the same geographical area	Frequency range for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
GSM900	921 - 960 MHz	-57 dBm	100 kHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 8.
	876 - 915 MHz	-61 dBm	100 kHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 8, since it is already covered by the requirement in sub-clause 9.1.4
DCS1800	1805 - 1880 MHz	-47 dBm	100 kHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 3.
	1710 - 1785 MHz	-61 dBm	100 kHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 3, since it is already covered by the requirement in sub-clause 9.1.4.
PCS1900	1930 - 1990 MHz	-47 dBm	100 kHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 2 or band 25.
	1850 - 1910 MHz	-61 dBm	100 kHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 2 or band 25, since it is already covered by the requirement in sub-clause 9.1.4.
GSM850 or CDMA850	869 - 894 MHz	-57 dBm	100 kHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 5
	824 - 849 MHz	-61 dBm	100 kHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 5, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band I or	2110 - 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 1,
E-UTRA Band 1	1920 - 1980 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 1, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band II or	1930 - 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 2 or band 25.
E-UTRA Band 2	1850 - 1910 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 2 or band 25, since it is already covered by the requirement in sub-clause 9.1.4
UTRA FDD Band III or	1805 - 1880 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 3.

System type operating in the same geographical area	Frequency range for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
E-UTRA Band 3	1710 - 1785 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 3, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band IV or E-UTRA Band 4	2110 - 2155 MHz 1710 - 1755 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 4 This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 4, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band V or E-UTRA Band 5	869 – 894 MHz 824 – 849 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 5 This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 5, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band VI, XIX or E-UTRA Band 6, 18, 19	860 – 895 MHz 815 – 850 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 6, 18 or 19. This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 6, 18 or 19, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band VII or E-UTRA Band 7	2620 - 2690 MHz 2500 - 2570 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 7. This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 7, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band VIII or E-UTRA Band 8	925 – 960 MHz 880 – 915 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 8. This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 8, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band IX or E-UTRA Band 9	1844.9 - 1879.9 MHz 1749.9 - 1784.9 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 9. This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 9, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band X or E-UTRA Band 10	2110 - 2170 MHz 1710 - 1770 MHz	-52 dBm -49 dBm	1 MHz 1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 10 This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 10, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band XI or XXI or	1475.9 - 1510.9 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 11 or 21

System type operating in the same geographical area	Frequency range for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
E-UTRA Band 11 or 21	1427.9 - 1462.9 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 11 or 21, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band XIII or	746 - 756 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 13.
E-UTRA Band 13	777 - 787 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 13, since it is already covered by the requirement in sub-clause 9.1.4.
E-UTRA Band 17	704 - 716 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 17, since it is already covered by the requirement in sub-clause 9.1.4.
E-UTRA Band 20	832 - 862 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 20, since it is already covered by the requirement in sub-clause 9.1.4.
UTRA FDD Band XXII or	3510-3590 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 22.
E-UTRA Band 22	3410 – 3490 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 22 since it is already covered by the requirement in sub-clause 9.1.4.
E-UTRA Band 23	2180 – 2200 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 23.
	2000 - 2020 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 23 since it is already covered by the requirement in sub-clause 9.1.4. This requirement does not apply to E-UTRA FDD Repeater operating in band 2 or band 25, where the limits are defined separately.
	2000 – 2010 MHz	-30 dBm	1 MHz	This requirement only applies to the uplink E-UTRA FDD Repeater operating in band 2 or band 25. This requirement applies starting 5 MHz above the band 25 downlink operating band.
	2010 – 2020 MHz	-49 dBm	1 MHz	
E-UTRA Band 24	1525 – 1559 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA Repeaters operating in band 24.
	1626.5 – 1660.5 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA Repeater operating in band 24, since it is already covered by the requirement in subclause 9.1.4.
UTRA FDD Band XXV or	1930 – 1995 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA FDD Repeater operating in band 2 or band 25.
E-UTRA Band 25	1850 – 1915 MHz	-49 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 25 since it is already covered by the requirement in sub-clause 9.1.4. For E-UTRA FDD Repeater operating in band 2, it applies for 1910 MHz to 1915 MHz, while the rest is covered in sub-clause 9.1.4

System type operating in the same geographical area	Frequency range for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
UTRA TDD in Band a) or E-UTRA Band 33	1900 - 1920 MHz	-52 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 1.
		-53 dBm	100 kHz	This requirement is applied only to the uplink of E-UTRA FDD Repeater operating in band 1.
UTRA TDD in Band a) or E-UTRA Band 34	2010 - 2025 MHz	-52 dBm	1 MHz	
UTRA TDD in Band b) or E-UTRA Band 35	1850 – 1910 MHz	-52 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 2.
		-53 dBm	100 kHz	This requirement is applied only to the uplink of E-UTRA FDD Repeater operating in band 2.
UTRA TDD in Band b) or E-UTRA Band 36	1930 - 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to the downlink of E-UTRA FDD Repeater operating in band 2.
UTRA TDD in Band c) or E-UTRA Band 37	1910 - 1930 MHz	-52 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 2 This unpaired band is defined in ITU-R M.1036, but is pending any future deployment.
		-53 dBm	100 kHz	This requirement is applied only to the uplink of E-UTRA FDD Repeater operating in band 2.
UTRA TDD in Band d) or E-UTRA Band 38	2570 – 2620 MHz	-52 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 7.
		-53 dBm	100 kHz	This requirement is applied only to the uplink of E-UTRA FDD Repeater operating in band 7.
E-UTRA Band 39	1880 – 1920 MHz	-52 dBm	1 MHz	This requirement does not apply to the uplink of E-UTRA FDD Repeater operating in band 1.
		-53 dBm	100 kHz	This requirement is applied only to the uplink of E-UTRA FDD Repeater operating in band 1.
E-UTRA Band 40	2300 – 2400 MHz	-52 dBm	1 MHz	
E-UTRA Band 41	2496 – 2690 MHz	-52 dBm	1 MHz	
E-UTRA Band 42	3400 – 3600 MHz	-52 dBm	1 MHz	
E-UTRA Band 43	3600 – 3800 MHz	-52 dBm	1 MHz	

Appendix B: FCC Title47. Part27.53 Spurious Emission Limits

B.1 Spurious Emission Limits of DL Signal

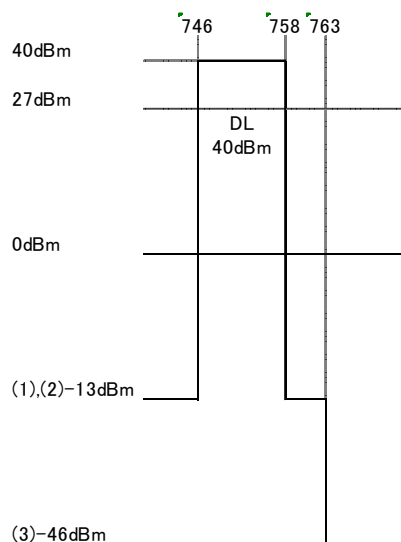


Figure 10 Spurious Emission Limits of DL Signal

B.2 Spurious Emission Limits of UL Signal

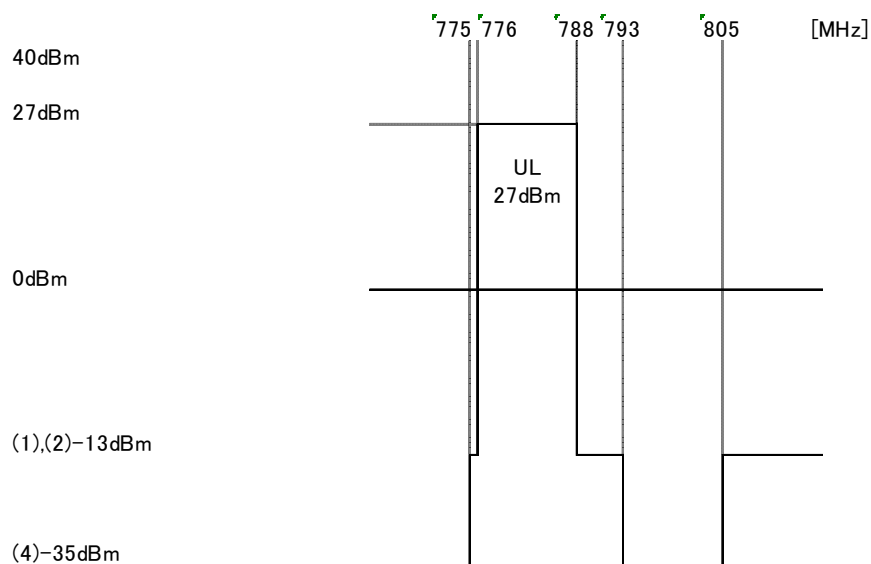


Figure 11 Spurious Emission Limits of UL Signal