
1. Safety Precautions

1-1. Repair Precaution

- Before attempting any repair or detailed tuning, shield the device from RF noise or static electricity discharges.
(Use only antistatic glove and strape.)
- Do not touch metallic parts or circuits with your bare hands as device(parts, circuits, etc) may be corroded.
- Use only demagnetized tools that are specifically designed for small electronic repairs, as most electronic parts are sensitive to electromagnetic forces.
- Use only high quality screwdrivers when servicing products. Low quality screwdrivers can easily damage the heads of screws.
- Use only conductor wire of the properly gauge and insulation for low resistance, because of the low margin of error of most testing equipment.
We recommend 22-gauge twisted copper wire.
- Hand-soldering is not recommended, because printed circuit boards (PCBs) can be easily damaged, even with relatively low heat. Never use a soldering iron with a power rating of more than 100 watts and use only lead-free solder with a melting point below 250°C (482°F).
- Prior to disassembling the battery charger for repair, ensure that the AC power is disconnected.
Always use the replacement parts that are registered in the SEC system. Third-party replacement parts may not function properly.

1. Safety Precautions

1-2. ESD(Electrostatically Sensitive Devices) Precaution

Many semiconductors and ESDs in electronic devices are particularly sensitive to static discharge and can be easily damaged by it. We recommend protecting these components with conductive anti-static bags when you store or transport them.

- Always use an anti-static strap or wristband and remove electrostatic buildup or dissipate static electricity from your body before repairing ESDs.
- Ensure that soldering irons have AC adapter with ground wires and that the ground wires are properly connected.
- Use only desoldering tools with plastic tips to prevent static discharge.
- Properly shield the work environment from accidental electrostatic discharge before opening packages containing ESDs.
- The potential for static electricity discharge may be increased in low humidity environments, such as air-conditioned rooms. Increase the airflow to the working area to decrease the chance of accidental static electricity discharges.

2. Specification

2-1. GSM General Specification

Item	GSM850	EGSM 900	DCS1800	PCS1900
Freq. Band[MHz] Uplink/ Downlink	824~849 869~894	880~915 925~960	1710~1785 1805~1880	1850~1910 1930~1990
ARFCN range	128~251	0~124 & 975~1023	512~885	512~810
Tx/Rx spacing	45MHz	45MHz	95MHz	80MHz
Mod. Bit rate/ Bit Period	270.833kbps 3.692us	270.833kbps 3.692us	270.833kbps 3.692us	270.833kbps 3.692us
Time Slot Period/ Frame Period	576.9us 4.615ms	576.9us 4.615ms	576.9us 4.615ms	576.9us 4.615ms
Modulation	0.3GMSK	0.3GMSK	0.3GMSK	0.3GMSK
MS Power (dBm)	33dBm~ 5dBm	33dBm~ 5dBm	30dBm~ 0dBm	30dBm~ 0dBm
Power Class	5pcl ~ 19pcl	5pcl ~ 19pcl	0pcl ~ 15pcl	0pcl ~ 15pcl
Sensitivity (QPSK, BW 10MHz) (dBm)	-102dBm	-102dBm	-100dBm	-100dBm
TDMA Mux	8	8	8	8
Cell Radius	35Km	35Km	2Km	2Km

2. Specification

2-2. WCDMA General Specification

Item	WCDMA 2100	WCDMA 1900	WCDMA 1700	WCDMA 850	WCDMA 900
Freq. Band[MHz] Uplink/ Downlink	1922~1977 2112~2167	1852~1907 1932~1987	1710~1755 2110~2155	824~849 869~894	880~915 925~960
ARFCN range	UL: 9612~9888 DL: 10562~10838	UL: 9262~9538 DL: 9662~9938	UL: 1312~1513 DL: 1537~1738	UL: 4132~4233 DL: 4357~4458	UL: 2712~2863 DL: 2937~3088
Tx/Rx spacing	190MHz	80MHz	400MHz	45MHz	45MHz
Mod. Bit rate/ Bit Period	3.84Mcps	3.84Mcps	3.84Mcps	3.84Mcps	3.84Mcps
Time Slot Period/ Frame Period	FrameLength: 10ms Slotlength: 0.667ms	FrameLength: 10ms Slotlength: 0.667ms	FrameLength: 10ms Slotlength: 0.667ms	FrameLength: 10ms Slotlength: 0.667ms	FrameLength: 10ms Slotlength: 0.667ms
Modulation	QPSK HQPSK	QPSK HQPSK	QPSK HQPSK	QPSK HQPSK	QPSK HQPSK
MS Power (dBm)	24dBm~ -50dBm	24dBm~ -50dBm	24dBm~ -50dBm	24dBm~ -50dBm	24dBm~ -50dBm
Power Class	3(max+24dBm)	3(max+24dBm)	3(max+24dBm)	3(max+24dBm)	3(max+24dBm)
Sensitivity (QPSK, BW 10MHz) (dBm)	-106.7dBm	-106.7dBm	-106.7dBm	-106.7dBm	-106.7dBm
TDMA Mux	8	8	8	8	8
Cell Radius	2Km	2Km	2Km	2Km	2Km

2. Specification

2-3. CDMA General Specification

Item	US PCS	CDMA	CDMA BC10	GPS
Tx Freq. range	1850 ~ 1910MHz	824.04 ~ 848.97MHz	817.9 ~ 823.1MHz	-
Rx Freq. range	1930 ~ 1990MHz	869.04 ~ 893.97MHz	862.9 ~ 868.1MHz	1575.42MHz
Channel Bandwidth	1.23MHz	1.23MHz	1.23MHz	-
Channel Spacing	50KHz	30KHz	25KHz	Not Used
Number of Channel	1200	832	205	1
Duplex Separation	80MHz	45MHz	45MHz	-
Type of Emission	1M28F9W	1M28F9W	1M27F9W	-
Tx Local Frequency	$F_{Tx} * 0.7999$	$F_{Tx} * 1.6666$	$F_{Tx} * 1.6666$	-
Rx Local Frequency	$F_{Rx} * 0.8888$	$F_{Rx} * 2$	$F_{Rx} * 2$	-
Frequency Stability	$(F_{Rx}-80\text{MHz})\pm 150\text{Hz}$	$(F_{Rx}-45\text{MHz})\pm 300\text{Hz}$	$(F_{Rx}-45\text{MHz})\pm 300\text{Hz}$	-
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

2-4. GSM Tx Power Class

TX Power control level	GSM850	TX Power control level	EGSM900	TX Power control level	DCS1800	TX Power control level	PCS1900
5	33±2 dBm	5	33±2 dBm	0	30±3 dBm	0	30±3 dBm
6	31±2 dBm	6	31±2 dBm	1	28±3 dBm	1	28±3 dBm
7	29±2 dBm	7	29±2 dBm	2	26±3 dBm	2	26±3 dBm
8	27±2 dBm	8	27±2 dBm	3	24±3 dBm	3	24±3 dBm
9	25±2 dBm	9	25±2 dBm	4	22±3 dBm	4	22±3 dBm
10	23±2 dBm	10	23±2 dBm	5	20±3 dBm	5	20±3 dBm
11	21±2 dBm	11	21±2 dBm	6	18±3 dBm	6	18±3 dBm
12	19±2 dBm	12	19±2 dBm	7	16±3 dBm	7	16±3 dBm
13	17±2 dBm	13	17±2 dBm	8	14±3 dBm	8	14±3 dBm
14	15±2 dBm	14	15±2 dBm	9	12±4 dBm	9	12±4 dBm
15	13±2 dBm	15	13±2 dBm	10	10±4 dBm	10	10±4 dBm
16	11±3 dBm	16	11±3 dBm	11	8±4 dBm	11	8±4 dBm
17	9±3dBm	17	9±3dBm	12	6±4 dBm	12	6±4 dBm
18	7±3 dBm	18	7±3 dBm	13	4±4 dBm	13	4±4 dBm
19	5±3 dBm	19	5±3 dBm	14	2±5 dBm	14	2±5 dBm
-	-	-	-	15	0±5 dBm	15	0±5 dBm

2. Specification

2-5. LTE General Specification

Item	LTE FDD B1	LTE FDD B2	LTE FDD B3	LTE FDD B4
Tx Freq. range	1920~1980 MHz	1850 ~ 1910 MHz	1710 ~ 1785 MHz	1710~1755 MHz
Rx Freq. range	2110~2170 MHz	1930 ~ 1990 MHz	1805 ~ 1880 MHz	2110~2155 MHz
Channel Bandwidth	5, 10, 15, 20MHz	1.4, 3, 5, 10, 15, 20 MHz	1.4, 3, 5, 10, 15, 20 MHz	1.4, 3, 5, 10, 15, 20 MHz
Channel Spacing	180KHz	180KHz	180KHz	180KHz
Number of Channel	25, 50, 75, 100	6, 15, 25, 50, 75, 100	6, 15, 25, 50, 75, 100	6, 15, 25, 50, 75, 100
Duplex Separation	190 MHz	80 MHz	95 MHz	400 MHz
Type of Emission	4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M10G7D (QPSK) 1M11W7D (16QAM) 1M11W7D (64QAM) 1M11W7D (256QAM) 2M72G7D (QPSK) 2M72W7D (16QAM) 2M72W7D (64QAM) 2M72W7D (256QAM) 4M53G7D (QPSK) 4M53W7D (16QAM) 4M52W7D (64QAM) 4M50W7D (256QAM) 9M02G7D (QPSK) 9M03W7D (16QAM) 9M03W7D (64QAM) 9M03W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M11G7D (QPSK) 1M11W7D (16QAM) 1M11W7D (64QAM) 1M11W7D (256QAM) 2M71G7D (QPSK) 2M71W7D (16QAM) 2M71W7D (64QAM) 2M71W7D (256QAM) 4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M10G7D (QPSK) 1M10W7D (16QAM) 1M10W7D (64QAM) 1M10W7D (256QAM) 2M70G7D (QPSK) 2M71W7D (16QAM) 2M71W7D (64QAM) 2M71W7D (256QAM) 4M51G7D (QPSK) 4M52W7D (16QAM) 4M52W7D (64QAM) 4M52W7D (256QAM) 9M01G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	LTE FDD B5	LTE FDD B7	LTE FDD B8	LTE FDD B12
Tx Freq. range	824 ~ 849 MHz	2500~2570 MHz	880 ~ 915 MHz	699 ~ 716 MHz
Rx Freq. range	869 ~ 894 MHz	2620~2690 MHz	925 ~ 960 MHz	729 ~ 746 MHz
Channel Bandwidth	1.4, 3, 5, 10 MHz	5, 10,15, 20 MHz	1.4, 3, 5, 10 MHz	1.4, 3, 5, 10 MHz
Channel Spacing	180KHz	180KHz	180KHz	180KHz
Number of Channel	6, 15, 25, 50	25, 50, 75, 100	6, 15, 25, 50	25, 50, 75, 100
Duplex Separation	45 MHz	45 MHz	45 MHz	30 MHz
Type of Emission	1M10G7D (QPSK) 1M10W7D (16QAM) 1M10W7D (64QAM) 1M10W7D (256QAM) 2M70G7D (QPSK) 2M72W7D (16QAM) 2M72W7D (64QAM) 2M72W7D (256QAM) 4M51G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 9M01G7D (QPSK) 9M01W7D (16QAM) 9M01W7D (64QAM) 9M01W7D (256QAM)	4M53G7D (QPSK) 4M53G7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 9M01G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M11G7D (QPSK) 1M11W7D (16QAM) 1M11W7D (64QAM) 1M11W7D (256QAM) 2M71G7D (QPSK) 2M71W7D (16QAM) 2M71W7D (64QAM) 2M71W7D (256QAM) 4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM)	1M10G7D (QPSK) 1M10W7D (16QAM) 1M10W7D (64QAM) 1M10W7D (256QAM) 2M70G7D (QPSK) 2M72W7D (16QAM) 2M72W7D (64QAM) 2M72W7D (256QAM) 4M51G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 9M00G7D (QPSK) 9M03W7D (16QAM) 9M03W7D (64QAM) 9M03W7D (256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	LTE FDD B13	LTE FDD B14	LTE FDD B18	LTE FDD B19
Tx Freq. range	777~787 MHz	788 ~ 798 MHz	815 ~ 830 MHz	830 ~ 845 MHz
Rx Freq. range	746~756 MHz	758 ~ 768 MHz	860 ~ 875 MHz	875 ~ 890 MHz
Channel Bandwidth	5, 10 MHz	5, 10 MHz	5, 10, 15 MHz	5, 10, 15 MHz
Channel Spacing	180KHz	180KHz	180KHz	180KHz
Number of Channel	25, 50	25, 50	25, 50, 75	25, 50, 75
Duplex Separation	-31 MHz	-30 MHz	45 MHz	45 MHz
Type of Emission	4M51G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 8M99G7D (QPSK) 8M98W7D (16QAM) 8M98W7D (64QAM) 8M98W7D (256QAM)	4M54G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 9M02G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM)	4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM)	4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	LTE FDD B20	LTE FDD B25	LTE FDD B26	LTE FDD B28
Tx Freq. range	832 ~ 862 MHz	1850~1915 MHz	814 ~ 849 MHz	703 ~ 748 MHz
Rx Freq. range	791 ~ 821 MHz	1930~1995 MHz	859 ~ 894 MHz	758 ~ 803 MHz
Channel Bandwidth	5, 10, 15, 20 MHz	1.4, 3, 5, 10, 15, 20 MHz	1.4, 3, 5, 10, 15 MHz	3, 5, 10, 15, 20 MHz
Channel Spacing	180KHz	180KHz	180KHz	180KHz
Number of Channel	25, 50, 75, 100	6, 15, 25, 50, 75, 100	6, 15, 25, 50, 75	15, 25, 50, 75, 100
Duplex Separation	-41 MHz	80 MHz	45 MHz	55 MHz
Type of Emission	4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M10G7D (QPSK) 1M11W7D (16QAM) 1M11W7D (64QAM) 1M11W7D (256QAM) 2M72G7D (QPSK) 2M72W7D (16QAM) 2M72W7D (64QAM) 2M72W7D (256QAM) 4M53G7D (QPSK) 4M53W7D (16QAM) 4M52W7D (64QAM) 4M50W7D (256QAM) 9M02G7D (QPSK) 9M03W7D (16QAM) 9M03W7D (64QAM) 9M03W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M10G7D (QPSK) 1M10W7D (16QAM) 1M10W7D (64QAM) 1M10W7D (256QAM) 2M70G7D (QPSK) 2M72W7D (16QAM) 2M72W7D (64QAM) 2M72W7D (256QAM) 4M51G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 9M01G7D (QPSK) 9M01W7D (16QAM) 9M01W7D (64QAM) 9M01W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM)	2M71G7D (QPSK) 2M71W7D (16QAM) 2M71W7D (64QAM) 2M71W7D (256QAM) 4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	LTE FDD B30	LTE TDD B38	LTE TDD B39	LTE TDD B40
Tx Freq. range	2305 ~ 2315 MHz	2570 ~ 2620 MHz	1880~1920 MHz	2300 ~ 2400 MHz
Rx Freq. range	2350 ~ 2360 MHz	2570 ~ 2620 MHz	1880~1920 MHz	2300 ~ 2400 MHz
Channel Bandwidth	5, 10 MHz	5, 10, 15, 20 MHz	5, 10, 15, 20 MHz	5, 10, 15, 20 MHz
Channel Spacing	180KHz	180KHz	180KHz	180KHz
Number of Channel	25, 50	25, 50, 75, 100	25, 50, 75, 100	25, 50, 75, 100
Duplex Separation	45 MHz	-	-	-
Type of Emission	4M51G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 8M99G7D (QPSK) 8M98W7D (16QAM) 8M98W7D (64QAM) 8M98W7D (256QAM)	4M52G7D (QPSK) 4M53W7D (16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 9M00G7D (QPSK) 9M07W7D (16QAM) 9M07W7D (64QAM) 9M07W7D (256QAM) 13M6G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 17M9W7D (16QAM) 17M9W7D (64QAM) 17M9W7D (256QAM)	4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	4M50G7D (QPSK) 4M50W7D (16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	LTE TDD B41	LTE TDD B48	LTE FDD B66	LTE FDD B71
Tx Freq. range	2496~ 2690 MHz	3550~ 3700 MHz	1710 ~ 1780 MHz	663 ~ 698 MHz
Rx Freq. range	2496~ 2690 MHz	3550~ 3700 MHz	2110 ~ 2200 MHz	617 ~ 652 MHz
Channel Bandwidth	5, 10, 15, 20 MHz	5, 10, 15, 20 MHz	1.4, 3, 5, 10, 15, 20 MHz	5, 10, 15, 20 MHz
Channel Spacing	180KHz	180KHz	180KHz	180KHz
Number of Channel	25, 50, 75, 100	25, 50, 75, 100	6, 15, 25, 50, 75, 100	25, 50, 75, 100
Duplex Separation	-	-	400 MHz	-46 MHz
Type of Emission	4M51G7D (QPSK) 4M51W7D (16QAM) 4M51W7D (64QAM) 4M51W7D (256QAM) 9M01G7D (QPSK) 9M02W7D (16QAM) 9M02W7D (64QAM) 9M02W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 17M9W7D (16QAM) 17M9W7D (64QAM) 17M9W7D (256QAM)	4M54G7D (QPSK) 4M52W7D (16QAM) 4M52W7D (64QAM) 4M52W7D (256QAM) 9M04G7D (QPSK) 9M02W7D (16QAM) 9M02W7D (64QAM) 9M02W7D (256QAM) 13M5G7D (QPSK) 13M6W7D (16QAM) 13M6W7D (64QAM) 13M6W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	1M10G7D (QPSK) 1M10W7D (16QAM) 1M10W7D (64QAM) 1M10W7D (256QAM) 2M70G7D (QPSK) 2M71W7D (16QAM) 2M71W7D (64QAM) 2M71W7D (256QAM) 4M51G7D (QPSK) 4M52W7D (16QAM) 4M52W7D (64QAM) 4M52W7D (256QAM) 9M01G7D (QPSK) 9M00W7D (16QAM) 9M00W7D (64QAM) 9M00W7D (256QAM) 13M5G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)	4M56G7D (QPSK) 4M55W7D (16QAM) 4M55W7D (64QAM) 4M55W7D (256QAM) 9M05G7D (QPSK) 9M03W7D (16QAM) 9M03W7D (64QAM) 9M03W7D (256QAM) 13M6G7D (QPSK) 13M5W7D (16QAM) 13M5W7D (64QAM) 13M5W7D (256QAM) 18M0G7D (QPSK) 18M0W7D (16QAM) 18M0W7D (64QAM) 18M0W7D (256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	LTE FDD B29	LTE TDD B46
Tx Freq. range	-	-
Rx Freq. range	717 ~ 728MHz	5150 ~ 5925 MHz
Channel Bandwidth	3, 5,10 MHz	10, 20 MHz
Channel Spacing	180KHz	180KHz
Number of Channel	15, 25, 50	50, 100
Duplex Separation	-	-
Type of Emission	-	-
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

2-6. NR General Specification

Item	N2 FDD	N5 FDD	N12 FDD
Tx Freq. range	1850 ~ 1910MHz	824 ~ 849 MHz	699 ~ 716 MHz
Rx Freq. range	1930 ~ 1990MHz	869 ~ 894 MHz	729 ~ 746 MHz
Channel Bandwidth	5, 10, 15, 20MHz	5, 10, 15, 20MHz	5, 10, 15MHz
Subcarrier Spacing	15 KHz	15 KHz	15 KHz
Duplex Separation	80MHz	45MHz	30MHz
Type of Emission	4M51G7D($\pi/2$ -BPSK) 4M49G7D(QPSK) 4M50W7D(16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D($\pi/2$ -BPSK) 8M95G7D(QPSK) 8M96W7D(16QAM) 8M96W7D(64QAM) 8M96W7D(256QAM) 13M4G7D($\pi/2$ -BPSK) 13M4G7D(QPSK) 13M5W7D(16QAM) 13M5W7D (64QAM) 13M5W7D(256QAM) 17M8G7D($\pi/2$ -BPSK) 17M9G7D(QPSK) 17M9W7D(16QAM) 17M9W7D (64QAM) 17M9W7D(256QAM)	4M51G7D($\pi/2$ -BPSK) 4M51G7D(QPSK) 4M51W7D(16QAM) 4M51W7D (64QAM) 4M51W7D (256QAM) 8M97G7D($\pi/2$ -BPSK) 8M99G7D(QPSK) 8M99W7D(16QAM) 8M99W7D(64QAM) 8M99W7D(256QAM) 13M5G7D($\pi/2$ -BPSK) 13M5G7D(QPSK) 13M5W7D(16QAM) 13M5W7D (64QAM) 13M5W7D(256QAM) 17M9G7D($\pi/2$ -BPSK) 19M0G7D(QPSK) 19M0W7D(16QAM) 19M0W7D (64QAM) 19M0W7D(256QAM)	4M51G7D($\pi/2$ -BPSK) 4M52G7D(QPSK) 4M53W7D(16QAM) 4M53W7D (64QAM) 4M53W7D (256QAM) 8M94G7D($\pi/2$ -BPSK) 8M96G7D(QPSK) 8M97W7D(16QAM) 8M97W7D(64QAM) 8M97W7D(256QAM) 13M5G7D($\pi/2$ -BPSK) 13M5G7D(QPSK) 13M5W7D(16QAM) 13M5W7D (64QAM) 13M5W7D(256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	N25 FDD	N30 FDD	N41 TDD
Tx Freq. range	1850 ~ 1915MHz	2305 ~ 2015 MHz	2496 ~ 2690 MHz
Rx Freq. range	1930 ~ 1995MHz	2350 ~ 2360 MHz	2496 ~ 2690 MHz
Channel Bandwidth	5, 10, 15, 20, 25, 30, 40MHz	5, 10MHz	20, 30, 40, 50, 60, 80, 90, 100MHz
Subcarrier Spacing	15 KHz	15 KHz	30 KHz
Duplex Separation	80MHz	45MHz	-
Type of Emission	4M51G7D($\pi/2$ -BPSK) 4M49G7D(QPSK) 4M50W7D(16QAM) 4M50W7D (64QAM) 4M50W7D (256QAM) 9M00G7D($\pi/2$ -BPSK) 8M95G7D(QPSK) 8M96W7D(16QAM) 8M96W7D(64QAM) 8M96W7D(256QAM) 13M4G7D($\pi/2$ -BPSK) 13M4G7D(QPSK) 13M5W7D(16QAM) 13M5W7D (64QAM) 13M5W7D(256QAM) 17M8G7D($\pi/2$ -BPSK) 17M9G7D(QPSK) 17M9W7D(16QAM) 17M9W7D (64QAM) 17M9W7D(256QAM) 22M9G7D($\pi/2$ -BPSK) 23M0G7D(QPSK) 22M9W7D(16QAM) 22M9W7D (64QAM) 22M9W7D(256QAM) 28M6G7D($\pi/2$ -BPSK) 28M6G7D(QPSK) 28M6W7D(16QAM) 28M6W7D (64QAM) 28M6W7D(256QAM) 38M7G7D($\pi/2$ -BPSK) 38M7G5D(QPSK) 38M7W7D(16QAM) 38M0W7D (64QAM) 38M0W7D(256QAM)	4M51G7D($\pi/2$ -BPSK) 4M50G7D(QPSK) 4M51W7D(16QAM) 4M51W7D (64QAM) 4M51W7D (256QAM) 8M98G7D($\pi/2$ -BPSK) 8M99G7D(QPSK) 8M99W7D(16QAM) 9M99W7D(64QAM) 8M99W7D(256QAM)	18M0G7D($\pi/2$ -BPSK) 18M0G7D(QPSK) 17M9W7D(16QAM) 17M9W7D (64QAM) 17M9W7D(256QAM) 27M0G7D($\pi/2$ -BPSK) 26M9G7D(QPSK) 26M9W7D(16QAM) 26M9W7D (64QAM) 26M9W7D(256QAM) 35M9G7D($\pi/2$ -BPSK) 35M8G7D(QPSK) 35M9W7D(16QAM) 35M9W7D (64QAM) 35M9W7D(256QAM) 45M8G7D($\pi/2$ -BPSK) 45M9G7D(QPSK) 45M9W7D(16QAM) 45M9W7D (64QAM) 45M9W7D(256QAM) 57M8G7D($\pi/2$ -BPSK) 57M5G7D(QPSK) 57M7W7D(16QAM) 57M7W7D (64QAM) 57M7W7D(256QAM) 77M3G7D($\pi/2$ -BPSK) 77M3G7D(QPSK) 77M4W7D(16QAM) 77M4W7D (64QAM) 77M4W7D(256QAM) 86M7G7D($\pi/2$ -BPSK) 86M8G7D(QPSK) 86M8W7D(16QAM) 86M8W7D (64QAM) 86M8W7D(256QAM) 97M0G7D($\pi/2$ -BPSK) 97M9G7D(QPSK) 98M0W7D(16QAM) 98M0W7D (64QAM) 98M0W7D(256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	N48 TDD	N66 FDD	N71 FDD
Tx Freq. range	3550 ~ 3700 MHz	1710 ~ 1780 MHz	663 ~ 698 MHz
Rx Freq. range	3550 ~ 3700 MHz	2100 ~ 2200 MHz	617 ~ 652 MHz
Channel Bandwidth	10, 20, 40MHz	5, 10, 15, 20, 30, 40MHz	5, 10, 15, 20MHz
Subcarrier Spacing	30 KHz	15 KHz	15 KHz
Duplex Separation	-	400MHz	-46MHz
Type of Emission	8M99G7D($\pi/2$ -BPSK) 8M99G7D(QPSK) 8M99W7D(16QAM) 8M99W7D(64QAM) 8M99W7D(256QAM) 18M0G7D($\pi/2$ -BPSK) 17M9G7D(QPSK) 18M1W7D(16QAM) 18M1W7D(64QAM) 18M1W7D(256QAM) 35M7G7D($\pi/2$ -BPSK) 35M7G7D(QPSK) 35M8W7D(16QAM) 35M8W7D(64QAM) 35M8W7D(256QAM)	4M51G7D($\pi/2$ -BPSK) 4M49G7D(QPSK) 4M50W7D(16QAM) 4M50W7D(64QAM) 4M50W7D(256QAM) 9M00G7D($\pi/2$ -BPSK) 8M95G7D(QPSK) 8M96W7D(16QAM) 8M96W7D(64QAM) 8M96W7D(256QAM) 13M4G7D($\pi/2$ -BPSK) 13M4G7D(QPSK) 13M5W7D(16QAM) 13M5W7D(64QAM) 13M5W7D(256QAM) 17M8G7D($\pi/2$ -BPSK) 17M9G7D(QPSK) 17M9W7D(16QAM) 17M9W7D(64QAM) 17M9W7D(256QAM) 28M6G7D($\pi/2$ -BPSK) 28M6G7D(QPSK) 28M6W7D(16QAM) 28M6W7D(64QAM) 28M6W7D(256QAM) 38M7G7D($\pi/2$ -BPSK) 38M7G7D(QPSK) 38M6W7D(16QAM) 38M6W7D(64QAM) 38M6W7D(256QAM)	4M52G7D($\pi/2$ -BPSK) 4M54G7D(QPSK) 4M55W7D(16QAM) 4M55W7D(64QAM) 4M55W7D(256QAM) 9M01G7D($\pi/2$ -BPSK) 9M03G7D(QPSK) 9M01W7D(16QAM) 9M01W7D(64QAM) 9M01W7D(256QAM) 13M5G7D($\pi/2$ -BPSK) 13M5G7D(QPSK) 13M5W7D(16QAM) 13M5W7D(64QAM) 13M5W7D(256QAM) 18M0G7D($\pi/2$ -BPSK) 19M1G7D(QPSK) 19M0W7D(16QAM) 19M0W7D(64QAM) 19M0W7D(256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C	-30°C ~ +60°C

2. Specification

Item	N77 TDD	N78 TDD
Tx Freq. range	3300 ~ 4200 MHz	3300 ~ 3800 MHz
Rx Freq. range	3300 ~ 4200 MHz	3300 ~ 3800 MHz
Channel Bandwidth	20, 30, 40, 50, 60, 70, 80, 90, 100MHz	20, 30, 40, 50, 60, 70, 80, 90, 100MHz
Subcarrier Spacing	30 KHz	30 KHz
Duplex Separation	-	-
Type of Emission	17M9G7D($\pi/2$ -BPSK) / 17M9G7D(QPSK) 17M9W7D(16QAM) / 17M9W7D (64QAM) 17M9W7D(256QAM) / 27M0G7D($\pi/2$ -BPSK) 26M9G7D(QPSK) / 26M9W7D(16QAM) 26M9W7D (64QAM) / 26M9W7D(256QAM) 35M9G7D($\pi/2$ -BPSK) / 35M8G7D(QPSK) 35M9W7D(16QAM) / 35M9W7D (64QAM) 35M9W7D(256QAM) / 45M8G7D($\pi/2$ -BPSK) 45M9G7D(QPSK) / 45M9W7D(16QAM) 45M9W7D (64QAM) / 45M9W7D(256QAM) 57M8G7D($\pi/2$ -BPSK) / 57M5G7D(QPSK) 57M7W7D(16QAM) / 57M7W7D (64QAM) 57M7W7D(256QAM) / 64M3G7D($\pi/2$ -BPSK) 64M3G7D(QPSK) / 64M4W7D(16QAM) 64M4W7D (64QAM) / 64M4W7D(256QAM) 77M2G7D($\pi/2$ -BPSK) / 77M1G7D(QPSK) 77M1W7D(16QAM) / 77M1W7D (64QAM) 77M1W7D(256QAM) / 86M7G7D($\pi/2$ -BPSK) 86M8G7D(QPSK) / 86M8W7D(16QAM) 86M8W7D (64QAM) / 86M8W7D(256QAM) 96M7G7D($\pi/2$ -BPSK) / 96M7G7D(QPSK) 96M7W7D(16QAM) / 96M7W7D (64QAM) 96M7W7D(256QAM)	17M9G7D($\pi/2$ -BPSK) / 17M9G7D(QPSK) 17M9W7D(16QAM) / 17M9W7D (64QAM) 17M9W7D(256QAM) / 27M0G7D($\pi/2$ -BPSK) 26M9G7D(QPSK) / 26M9W7D(16QAM) 26M9W7D (64QAM) / 26M9W7D(256QAM) 35M9G7D($\pi/2$ -BPSK) / 35M8G7D(QPSK) 35M9W7D(16QAM) / 35M9W7D (64QAM) 35M9W7D(256QAM) / 45M8G7D($\pi/2$ -BPSK) 45M9G7D(QPSK) / 45M9W7D(16QAM) 45M9W7D (64QAM) / 45M9W7D(256QAM) 57M8G7D($\pi/2$ -BPSK) / 57M5G7D(QPSK) 57M7W7D(16QAM) / 57M7W7D (64QAM) 57M7W7D(256QAM) / 64M3G7D($\pi/2$ -BPSK) 64M3G7D(QPSK) / 64M4W7D(16QAM) 64M4W7D (64QAM) / 64M4W7D(256QAM) 77M2G7D($\pi/2$ -BPSK) / 77M1G7D(QPSK) 77M1W7D(16QAM) / 77M1W7D (64QAM) 77M1W7D(256QAM) / 86M7G7D($\pi/2$ -BPSK) 86M8G7D(QPSK) / 86M8W7D(16QAM) 86M8W7D (64QAM) / 86M8W7D(256QAM) 96M3G7D($\pi/2$ -BPSK) / 96M4G7D(QPSK) 96M5W7D(16QAM) / 96M5W7D (64QAM) 96M5W7D(256QAM)
Operating Temperature	-30°C ~ +60°C	-30°C ~ +60°C

3. Product Function

Specification

Item	Description
OS	Android R OS V11
Network	2G - GSM : GSM850 / GSM900 / DCS1800 / PCS1900 3G - WCDMA : B1 / B2 / B4 / B5 / B8 4G LTE - FDD : B1 / B2 / B3 / B4 / B5 / B7 / B8 / B12 / B13 / B14 / B18 / B19 / B20 / B25 / B26 / B28 / B29 / B30 / B66 / B71 - TDD : B38 / B39 / B40 / B41 / B46 / B48 5G - Sub6 : N2 / N5 / N12 / N25 / N30 / N41 / N48 / N66 / N71 / N77 / N78 - mmWave : N260 / N261
Battery	5,000 mAh
Processor	SM8350, 2.84 GHz / 2.4 GHz / 1.8 GHz
Connectivity	GPS, Glonass, Galileo, BT 5.2, USB 3.2, Wi-Fi 6E(a/b/g/n/ac/ax(2.4G,5GHz), ax(6GHz)), NFC
Camera	Rear - Wide : 108MP, A/F, OIS, F1.8 - Tele X3 : 10MP, A/F, OIS, F2.4 - Tele X10 : 10MP, A/F, OIS, F4.9 - Ultra Wide : 12MP, F2.2, A/F Front : 40MP, A/F, F2.2
Display	6.8" QHD+, Dynamic AMOLED 2X
RAM	12 GB / 16GB
ROM	128GB / 256GB / 512GB
Sensor	Accelerometer, Barometer, Fingerprint Sensor, Gyro Sensor, Geomagnetic Sensor, Hall Sensor, Light Sensor, Proximity Sensor

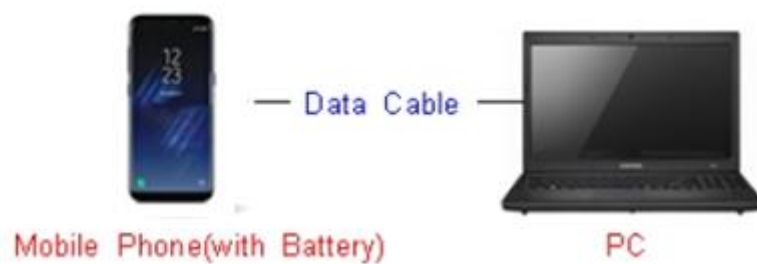
6. Level 1 Repair

6-1. S/W Update

6-1-1. Preparation

- S/W Update program: **Fenrir 5.20.xxxx**
- Mobile Phone
- Data Cable

※ Settings



Data Cable :
GH39-02023A
GH39-02025A
GH39-02031A
GH39-02033A

6. Level 1 Repair

6-1-2. How to use 'Fenrir' S/W update program.



1) Launch Fenrir by clicking on the icon on the desktop

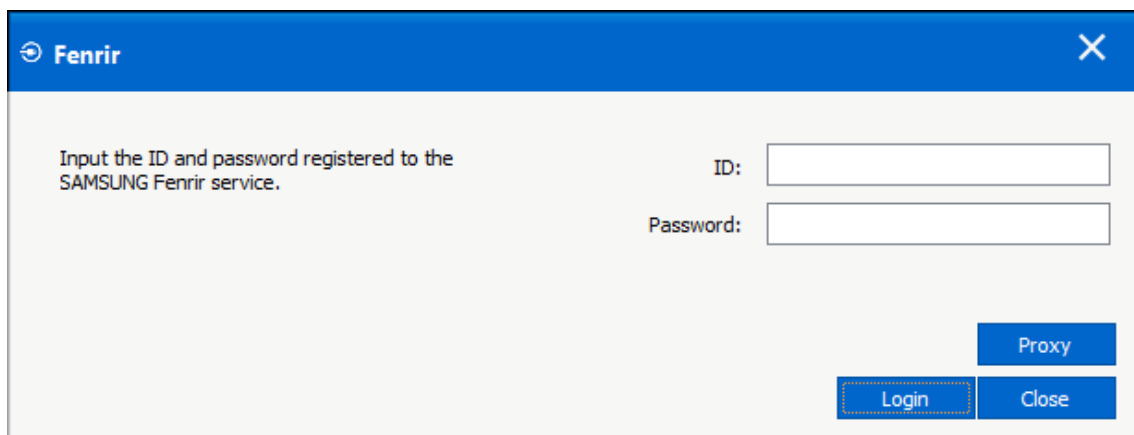
- SVH (Fenrir_Home) : It uses Home binary which does not have user data area in the memory when flashed to a device. (Keep user data)

- SVC (Fenrir_Factory) : It uses Factory binary which erases all user data in the memory when flashed to a device. (Clear user data)

- SVA (Fenrir_All) : It uses Factory and Home binaries. you can download Home and Factory binary in a PC. (but requires double HDD storage and NW traffic)

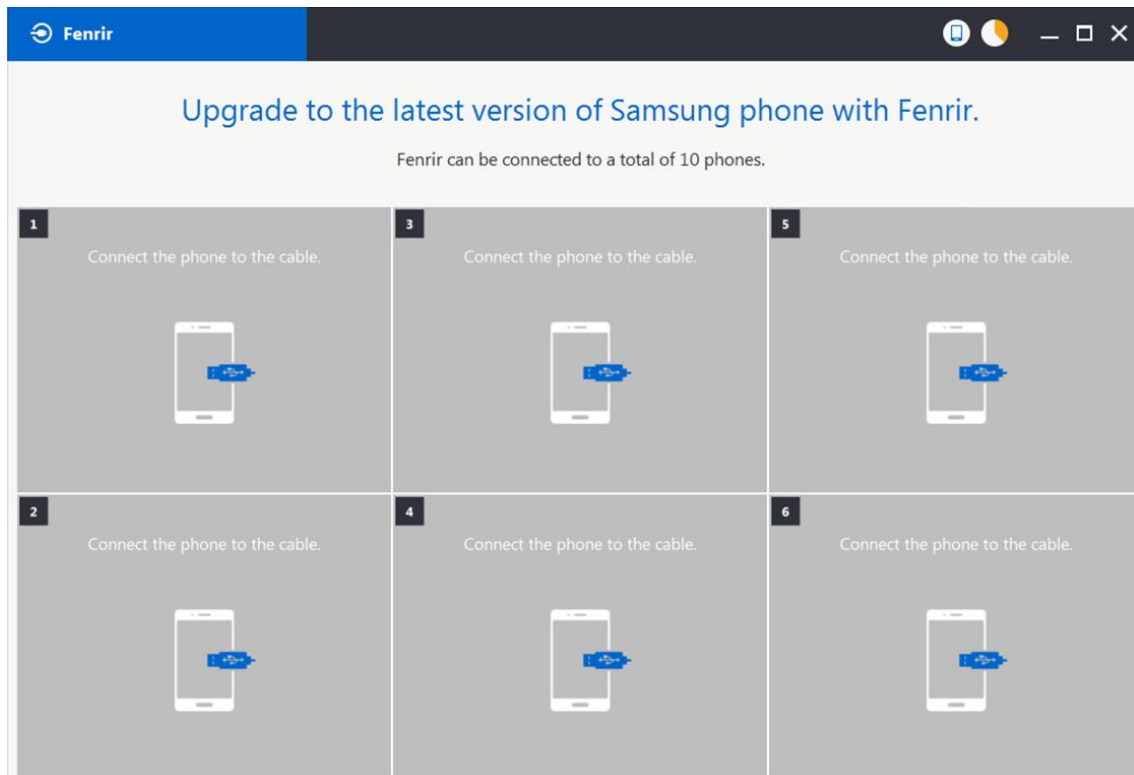
2) Input ID & password

※ You need to reset the ID information in case of PC change and format and repair, hard disk change.

A screenshot of the Fenrir software interface. It has a blue header bar with the 'Fenrir' logo and a close button (X). The main area is light gray and contains the text 'Input the ID and password registered to the SAMSUNG Fenrir service.' To the right of this text are two input fields: 'ID:' and 'Password:'. Below these fields are three buttons: 'Proxy' (blue), 'Login' (blue with a dashed border), and 'Close' (blue).

6. Level 1 Repair

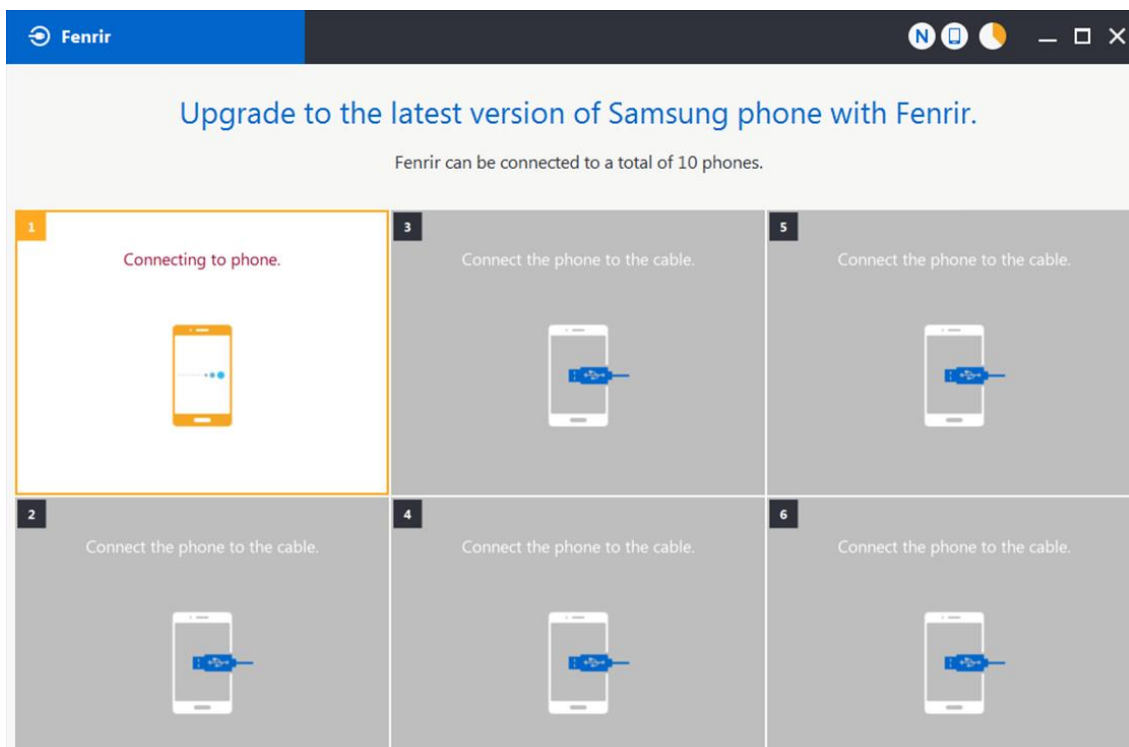
3) Ensure device has sufficient charge (at least 20%) to start firmware update.



4) Connect the device to PC via data cable.

6. Level 1 Repair

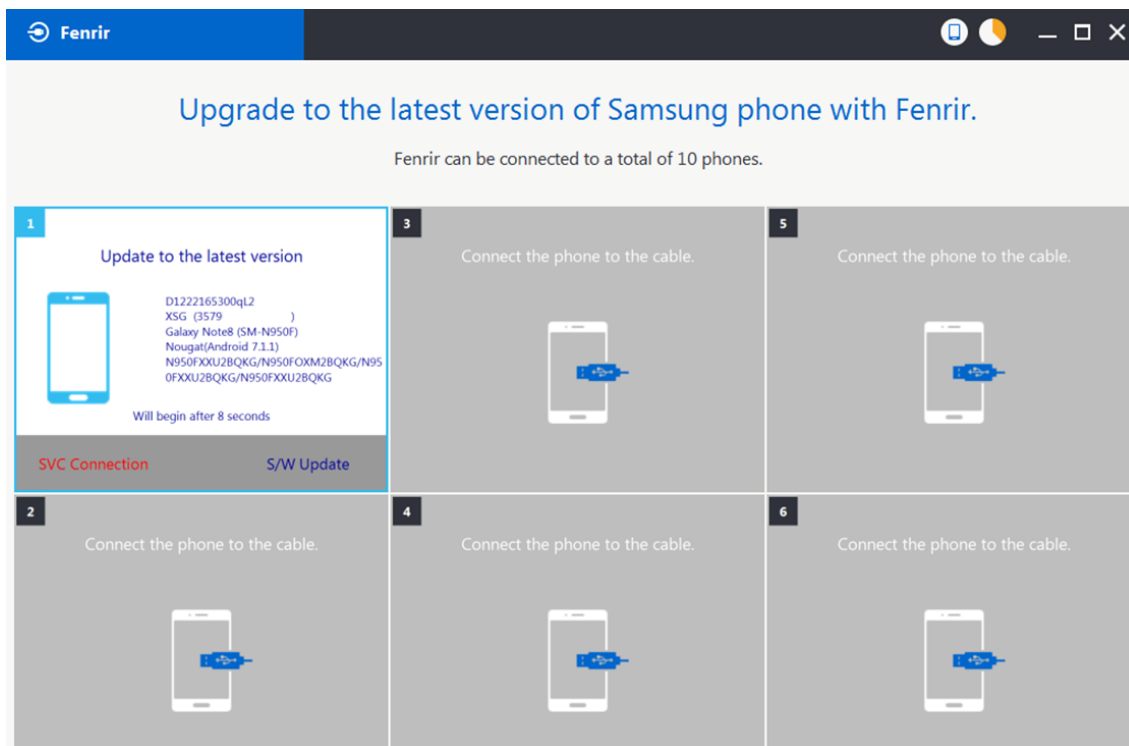
5) Upon USB connection, you will be presented with below screen.



6) Once device is detected, you will be presented with below screen.

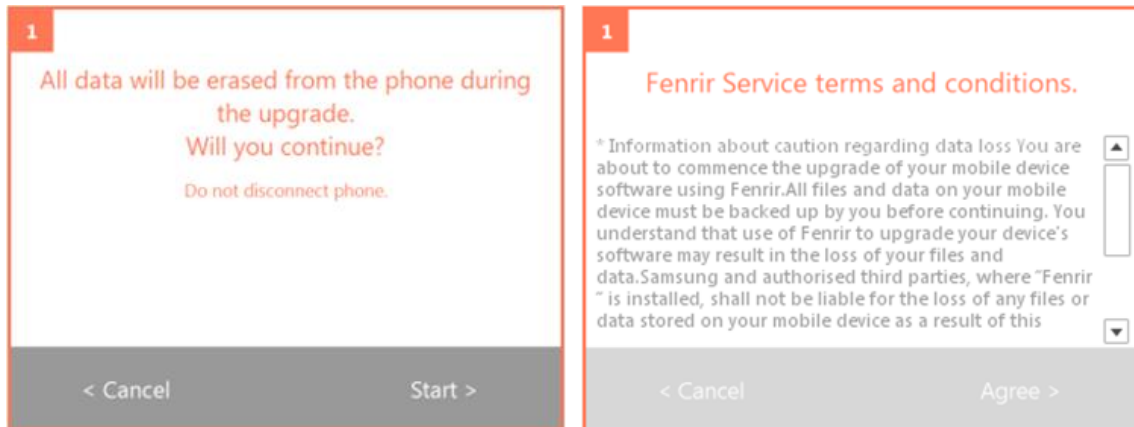
To update S/W, select "S/W Update" or to exit select "SVC Connection".

If you select "SVC Connection", only Fenrir connection history (record) will be stored in the FUS server to support warranty validation. (This is known as "Service Connection" history)

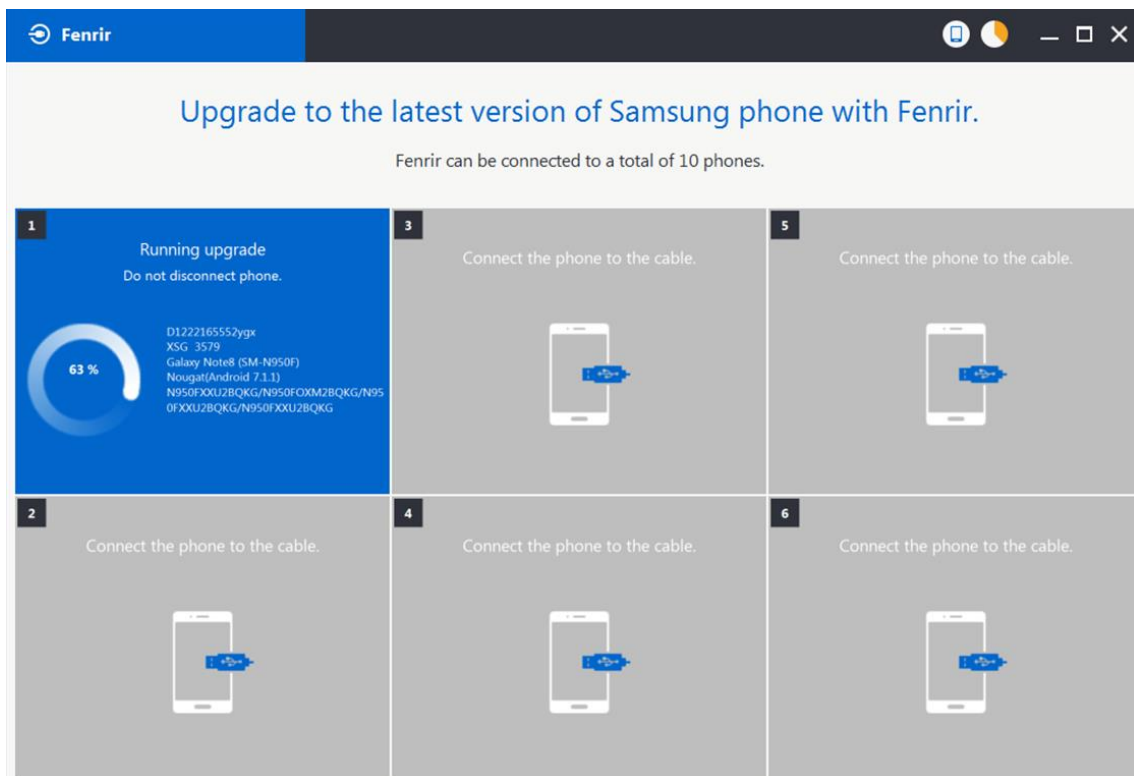


6. Level 1 Repair

7) Once Fenrir starts, application will display the below screen. And select the Start button & Agree button.

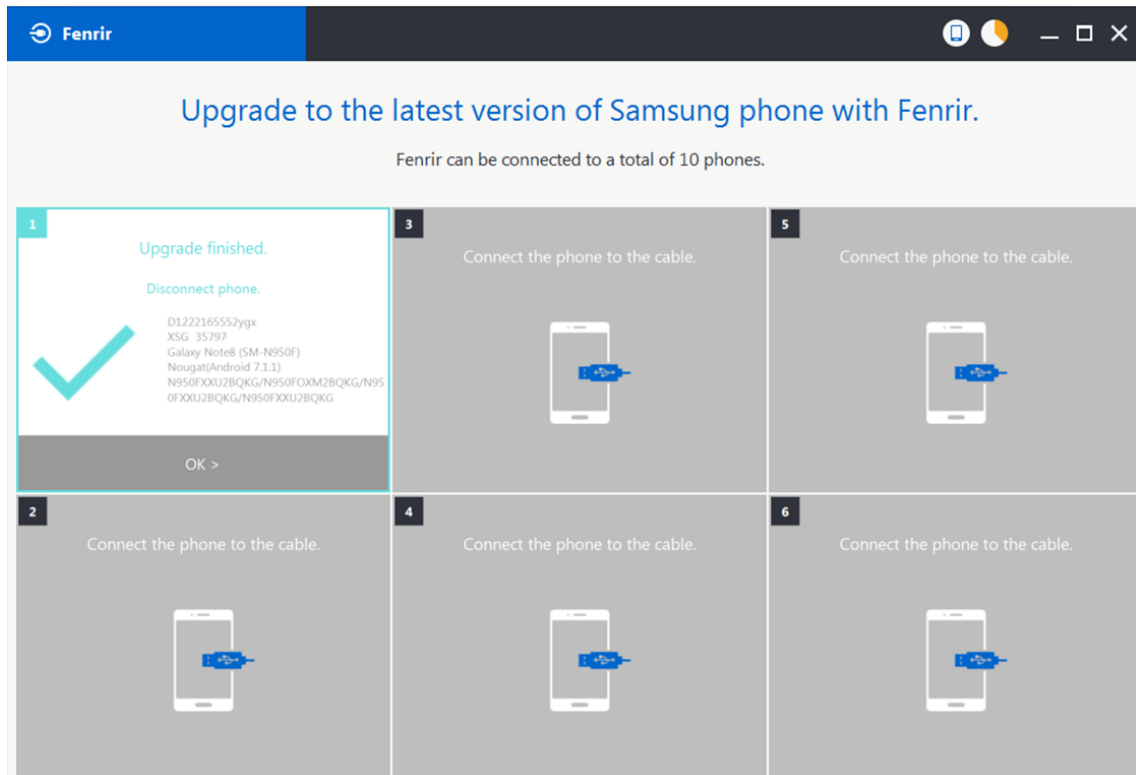


8) The status circle increases as the update installs.
The update process takes approximately 5-10 minutes to complete.
Do not disconnect the device from USB during processing.



6. Level 1 Repair

9) Once complete, application will present the below screen indicating update complete. Click Ok and detach device from USB.



6. Level 1 Repair

6-2. How to use 'Odin' program

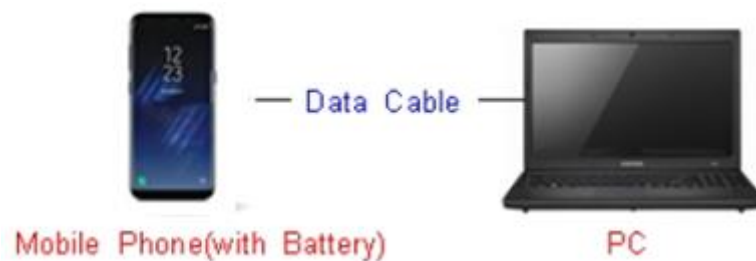
※ S/W Update via Fenrir is mandatory.

Below is the method to use 'Odin' program in any specific case.

6-2-1. Preparation

- Installation program: **Odin3 v3.14.4.exe or above**
- Mobile Phone
- Data Cable
- S/W Binary files (downloaded from GSPN)

※ Settings

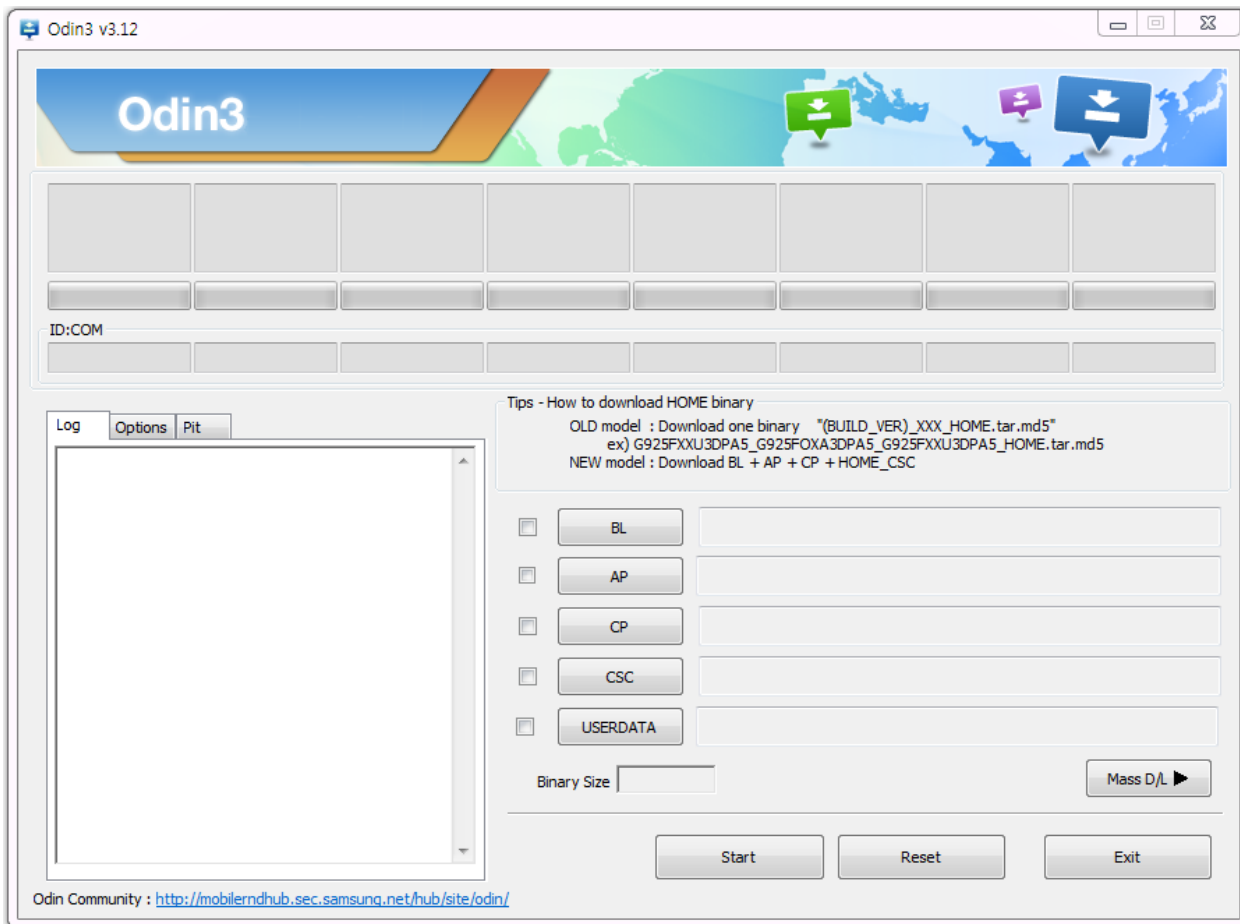


Data Cable :
GH39-02023A
GH39-02025A
GH39-02031A
GH39-02033A

6. Level 1 Repair

6-2-2. S/W Installation Program (Downloader program)

Open up the S/W Installation Program by executing the "**Odin3 v3.14.4.exe**"

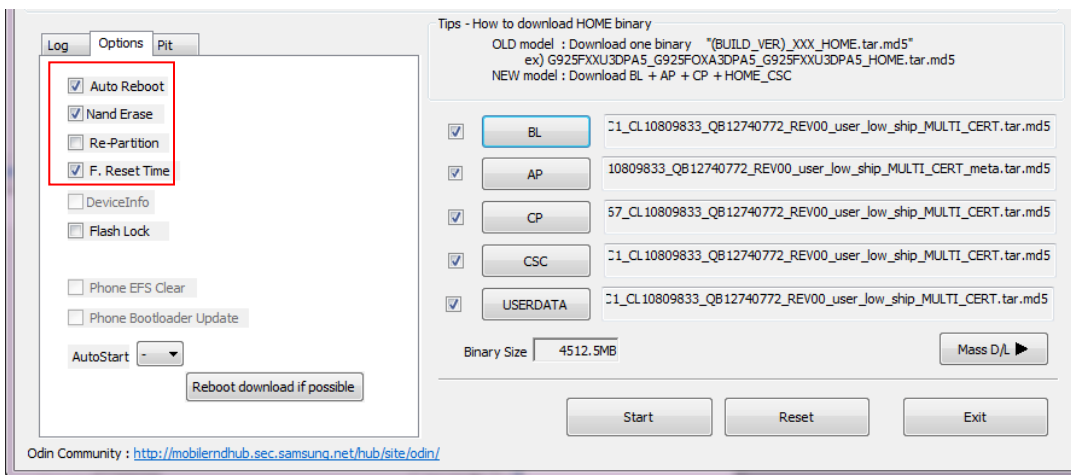
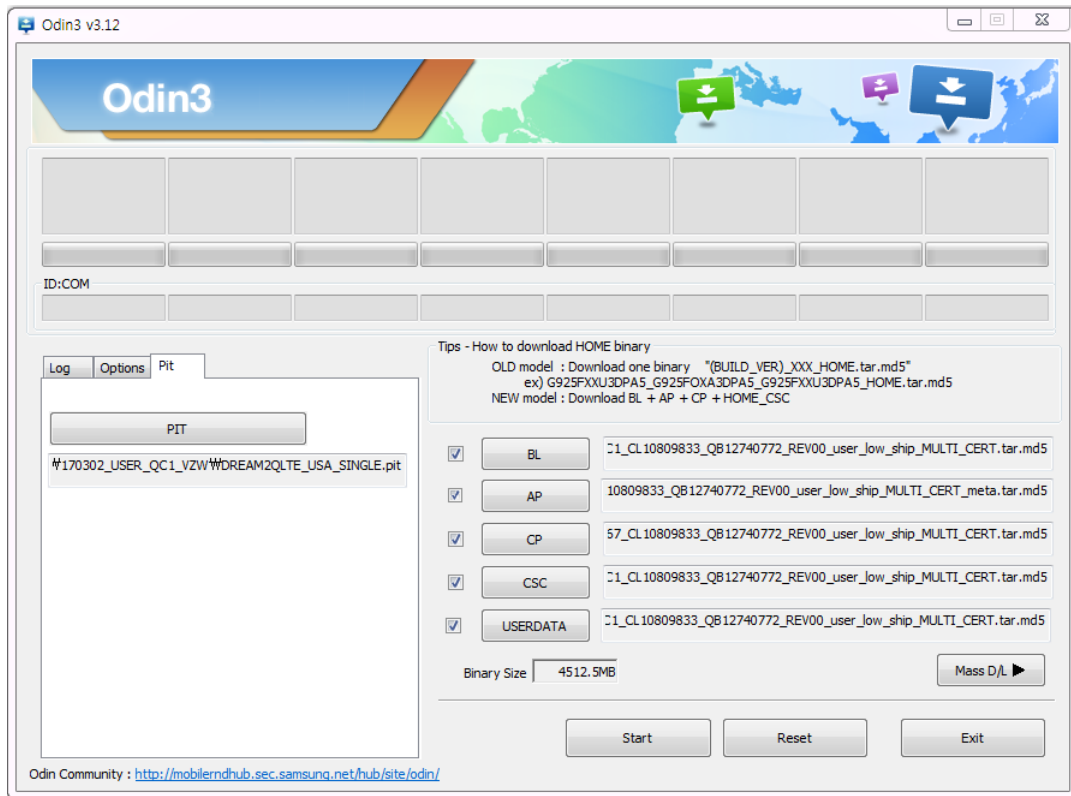


6. Level 1 Repair

1. Enable the check mark by click on the following options

- Check Auto Reboot, F. Reset Time, Nand Erase
- Check BOOTLOADER, PDA, PHONE, CSC and USERDATA Files

* Note : "Odin v3.14.4 or above" checks MD5 checksum just after file selection.



6. Level 1 Repair

2. Enter into Download Mode

- Enter into Download Mode by pressing 2 button(Volume Up button + Volume Down) simultaneously and connect USB cable.
- Press volume up button after 'Warning' message and 'Downloading' message is displayed.



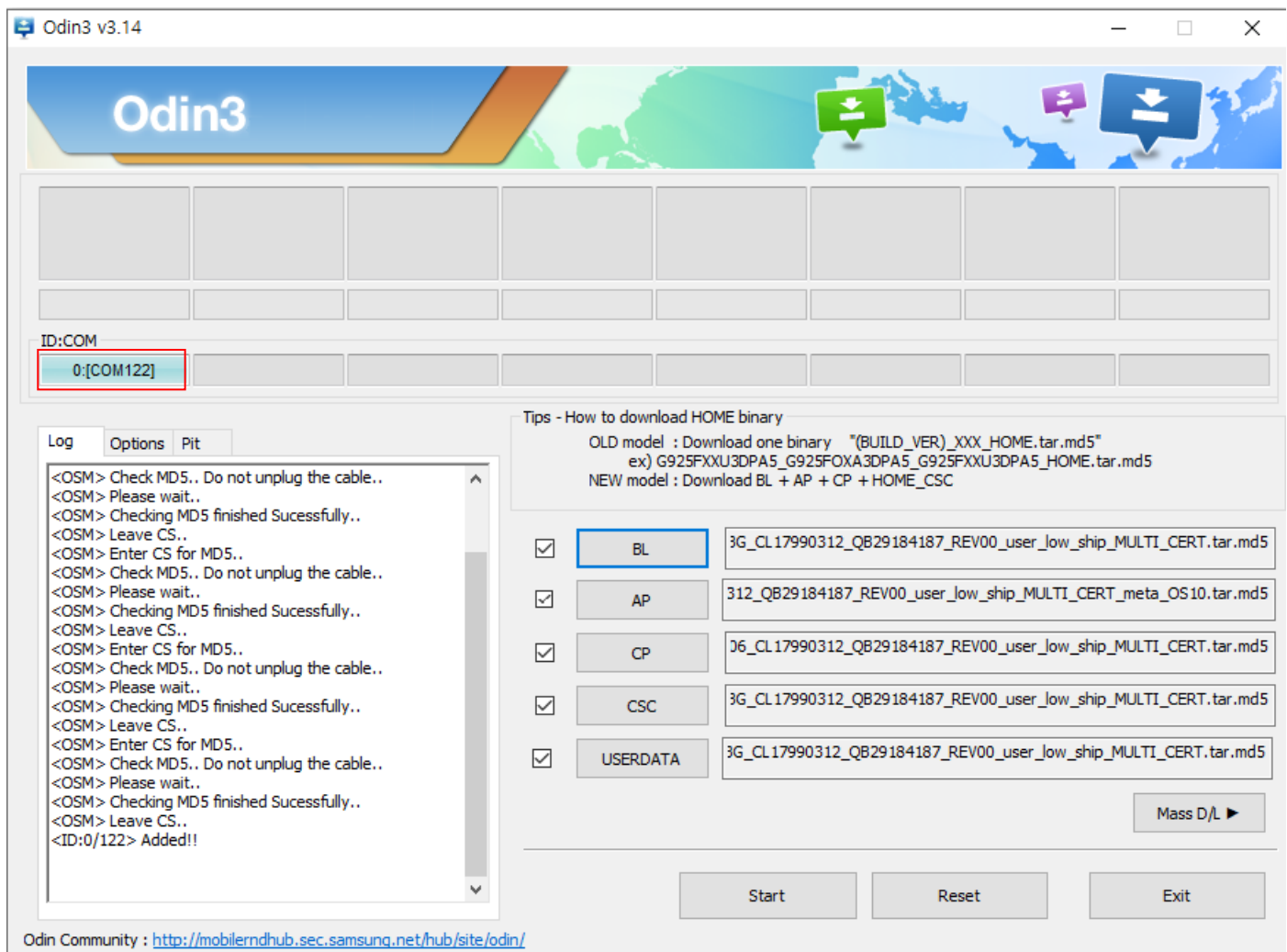
**Volume Up
+
Volume Down**

USB Cable

6. Level 1 Repair

3. Connect the device to PC via Data Cable.

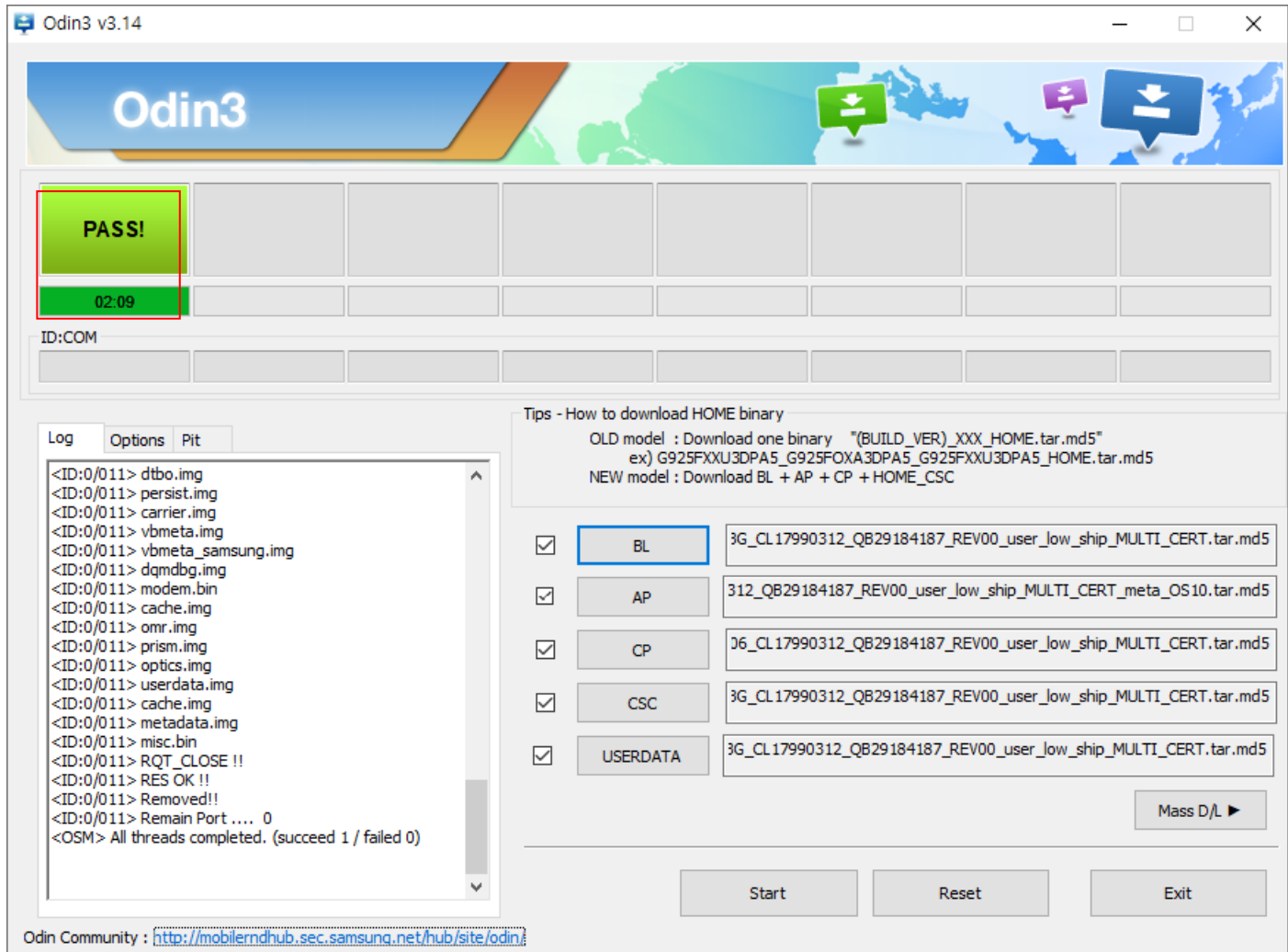
Make sure that the one of communication ports [ID:COM] box is highlighted in sky blue.
The device is now connected with the PC and ready to download the binary files in it.



6. Level 1 Repair

4. Start downloading the binary files into the device by clicking Start button on the screen.

The green colored "PASS!" sign will appear on the upper-left box if the binary files have been successfully downloaded into the device.



5. Disconnect the device from the Data cable.

6. Once the device boots up, you can check the version of the binary file or name by pressing the following code in sequence; ***#1234#**

You can perform Factory data Reset by Settings → General Management → Reset

※ Caution. Never disconnect during the S/W downloading.

6-3. IMEI writing

: Please check with the separate notice file about IMEI Guide.

9. Reference Abbreviation

Reference Abbreviation

- **AAC**: Advanced Audio Coding.
- **AVC** : Advanced Video Coding.
- **BER** : Bit Error Rate
- **BPSK**: Binary Phase Shift Keying
- **CA** : Conditional Access
- **CDM** : Code Division Multiplexing
- **C/I** : Carrier to Interference
- **DMB** : Digital Multimedia Broadcasting
- **EN** : European Standard
- **ES** : Elementary Stream
- **ETSI**: European Telecommunications Standards Institute
- **MPEG**: Moving Picture Experts Group
- **PN** : Pseudo-random Noise
- **PS** : Pilot Symbol
- **QPSK**: Quadrature Phase Shift Keying
- **RS** : Reed-Solomon
- **SI** : Service Information
- **TDM** : Time Division Multiplexing
- **TS** : Transport Stream