MITSUBISHI ELECTRIC

SERVICE MANUAL

FA9M068002

Trium®
by MITSUBISHI ELECTRIC

TRIUM 110

REVISIONS	VERSIONS					
		A: Création L. LUCE	05/02	Rédigé par *Written by*	Vérifié par *Checked by*	Approuvé par *Approuved by*
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Version A
Date: 05/02

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1 General description

M6A+ product is based on MARS product

1.1 Description of the kit

Commercial Name	TRIUM 110
Project Development Name	CUPID MT 360
- **TRIUM 110** : Standard version - **TRIUM110 m**: For messaging, EMS version - **TRIUM 110 p**: For play, EXEN version	**PICTURE** 

Main features:

Hand phone working with E-GSM/DCS networks
Hand phone including a WAP Browser 1.2.1 (Wireless Application Protocol)
Tri-codec Voice Encoding: Full Rate, Enhanced Full Rate and Half Rate
Integrated Hands-free
Integrated antenna (fixed in the case)
SMS (Short Message Service) with T9 (predictive text input)
Polyphonic melodies
Currency converter
Euro character managed (TBC)
Calculator
Clock/Date and Alarm
EXEN game
EMS (Enhanced Message Sending)

Dimension and battery feature:

Weight: 110g (including battery)
Dimension: 116mm x 44.7mm x 25.2mm
Talk Time: Up to 2h09min
Standby Time: 165h

Call management:

Up to 254 number stored in SIM card (depending on the Software and the SIM card)
100 names with 3 telephone numbers each and associated icons (VCARD)

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4 items are included in the standard kit:

- Cupid main unit
- Li-Ion main battery (3.8V – 800mAh)
- AC/DC Adapter for battery rapid charging
- User manual

Difference with MARS & M6A*

Features	Cupid	M6A*	MARS
Hardware			
Flash Memory	Flash 2Mbytes	4 Mbytes multi-bank	2 Mbytes
Memory	Flash 2Mbytes	None	EEPROM or Serial-Flash
Back up battery	No	No	Yes
Mechanical			
Handstrap	Yes	Yes	No
LED indicator	No	No	Yes

* M6A: AURA, MYSTRAL, ODYSSEY

1.2 Additional Accessories

Code article	Désignation	Ref Product
FK8A001910	AC/DC AU	MA0504
FK8A001810	AC/DC EU	MA0501
FK8A001710	AC/DC UK	MA0502
FK8A002710	AC/DC Chine	MA0503
FS2F006410	Battery M6A+	MA0632
FK8C000110	CLA M5	MA0513
To be defined	simple hand-free M5	MA0638
FK8T000110	PC cable Download professional	MA0524
FK8T000310	PC cable commercial Mars/Neptune	MA0571
FK8E000210	Headset FM radio	MA0512
FK8E000110	Standard Headset	MA0509
To be defined	Carrying Case	MA0605

This is a typical list, also the "**Spare Part List**" delivered by Mitsubishi **is the official document**.

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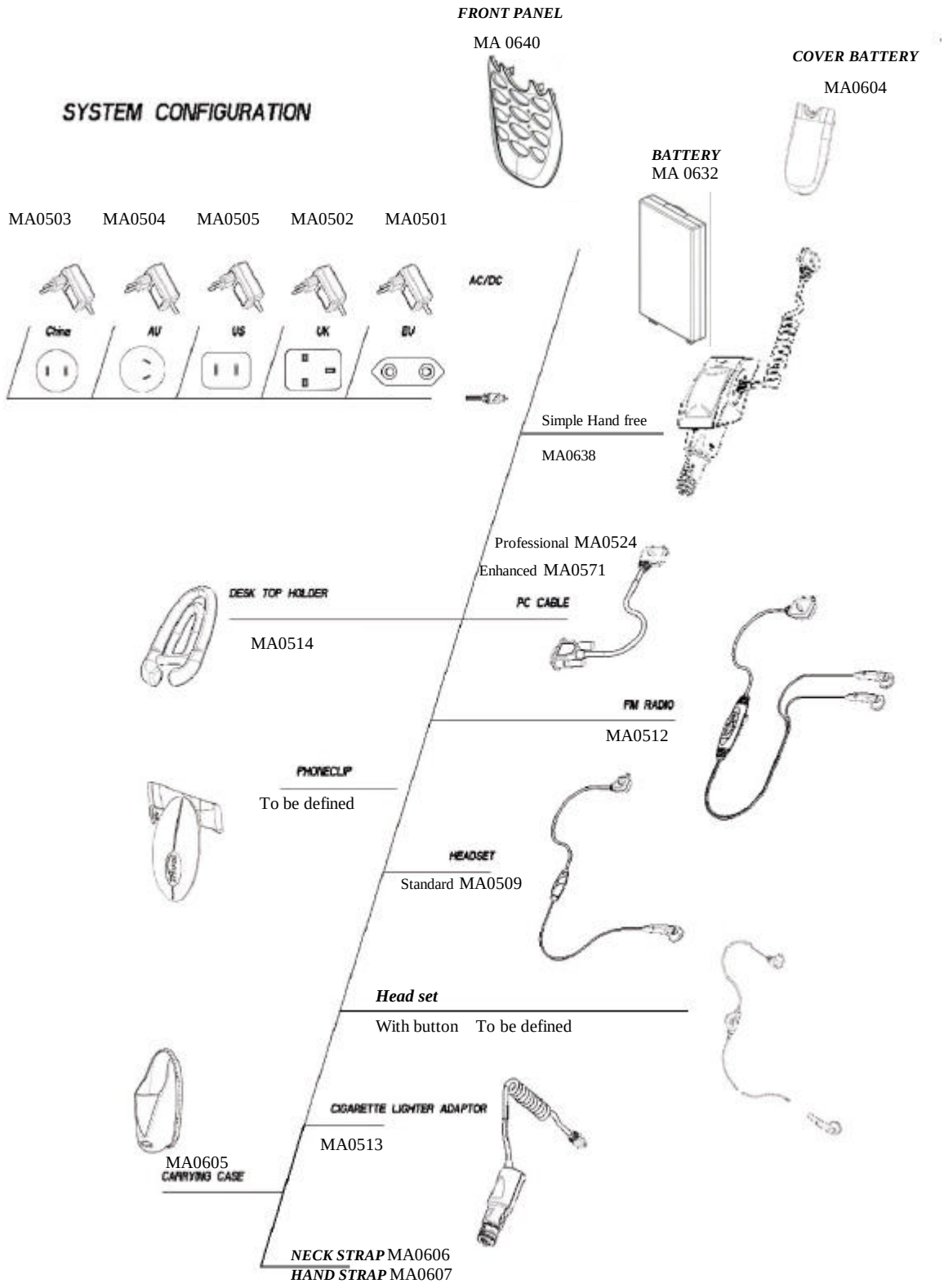
SYSTEM CONFIGURATION



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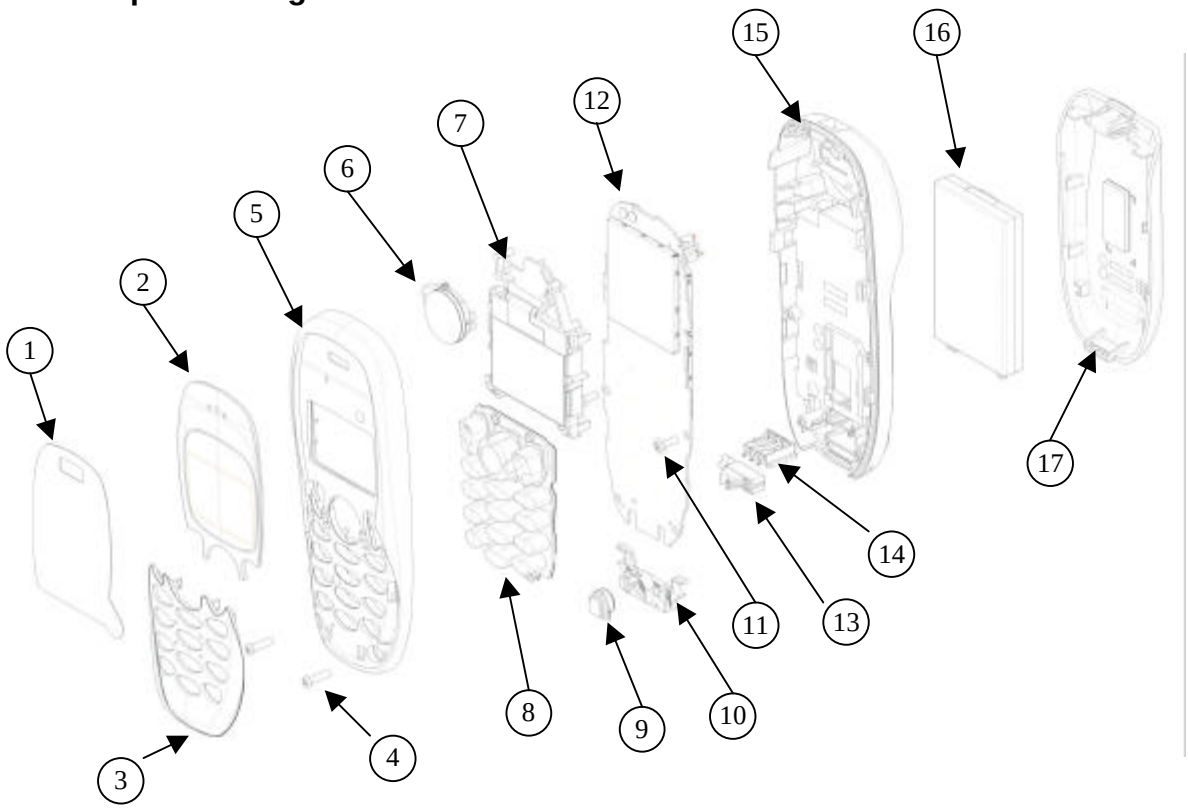
2 Assembly

2.1 Exploded diagram of M6A



2.2 Spare part list

Item	Description	Reference
1 & 2	Window Assy M6A+	? following the colour
3	Front Panel M6 MT360	FK1W00951A
4	Screw PI TITE Head TPR N°02*8 ZBL	FK1B002410
5	Cover Assy M6A+	? following the color
6	Multiactors (3/1) M6A+	FS2F005810
7	LCD Assy M6A+	FS13115410
8	Keypad M6a+	FK1K002010
9	Micro Assy M5 MA/NE	FS2E001410
10	Connector I/O M5 MA/NE	FS2E001310
11	Screw PI TITE BENTZ Head TPR N°02*6	FK1B001510
12	PCA test M6a+ (not available as spare part)	
13	Motor Vibrator M5 MA/NE	FS2E001710
14	Connector Battery M6A	FS2F000310
15	Case M6A+	? following the colour
16	Battery M6A+	
17	Battery Cover M6A+	FK1N027910
Not Identified	Cap RF M5 MA/NE	FS2E003610
Not Identified	Label Art (10 x 21) same as MA/NE	FS2D003110
Not Identified	Label IMEI same as MA/NE	FA9L012210

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2.3 Disassembly and Assembly Instruction

2.3.1 Disassembly Instruction

The procedure for mobile disassembly is described in the instruction **GFZ13136904 – TRIUM 110 Disassembly (M6A+ Cupid)**.

2.3.2 Assembly Instruction

The procedure for mobile assembly is described in the instruction **GFZ13136903 – TRIUM 110 Assembly (M6A+ Cupid)**.

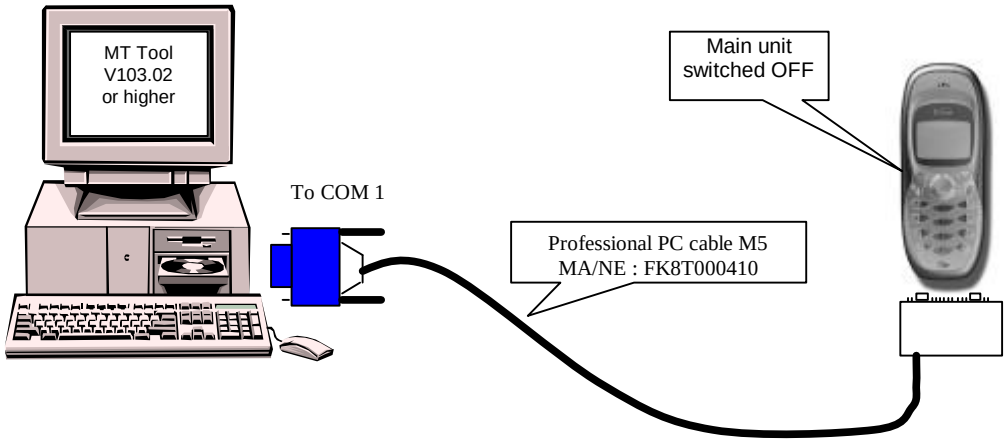
3 Download

The data are divided in two parts: the software and the settings.

Currently the Mitsubishi software (.bin file) is downloaded into the Flash and the setting (. pso file) is downloaded into an EEPROM or Serial Flash.
The M6A+ mobiles does not use EEPROM but a Flash Data and the setting are not in **.pso** extension but in **.psb** (as M6A). The main consequence of this change is that the **new setting file . psb** MUST BE DOWNLOADED WITH IPL TRIUM.
In conclusion, with the M6A product, the software and the setting can be downloaded in the same time by using IPL Trium.

3.1 Download of Software and settings

The configuration to download software is :



Launch **MT ToolsV103.02** or higher, select the "**Mobile Type M5-M6A**" and then launch **IPL Trium** in download/download software menu.

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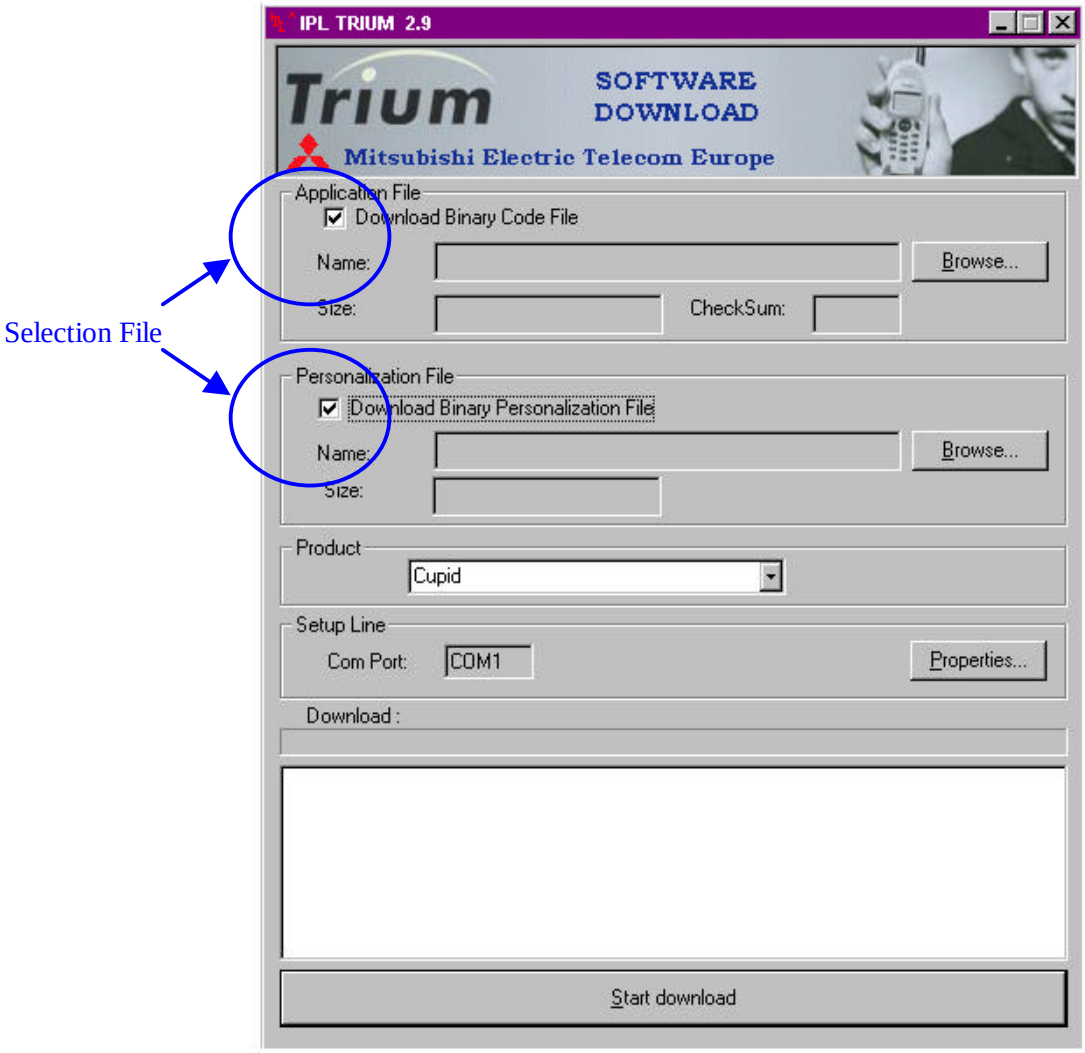

When IPL Trium is launched, the software or setting download is selected by choosing " ***Application File***" or "***Personalization File***"
Select the .bin file or .psb file or both, connect the PC cable to a switched off mobile, hold the power button and click on "***Start download***", the download starts when the back light blinks.
At the end of a successful download, the mobile displays "**Download success** ".

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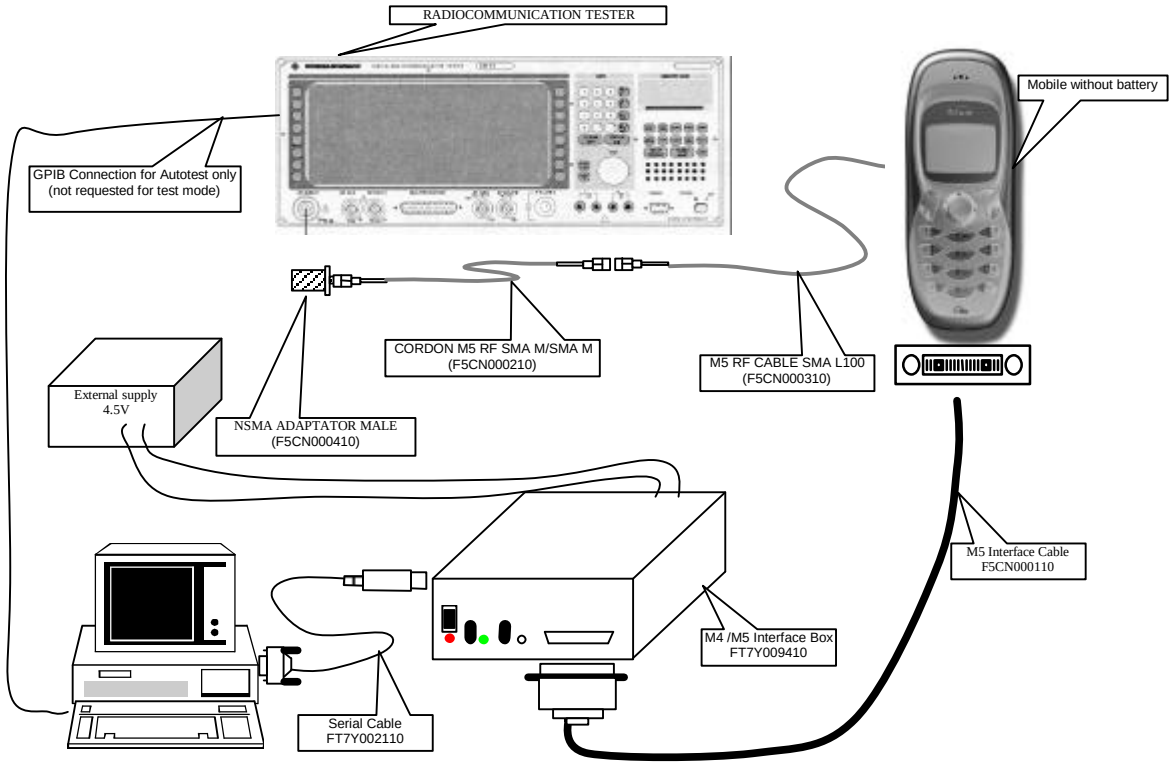
4 Basic Adjustment

For M6 family, test mode is not directly possible from the mobile, indeed relevant software is available on PC only.
Thanks to the new generation of MT Tools (MT Tools 2000), we can either repair Level 2 or Level 3.

4.1 Equipment installation



The test mode is used to control or adjust mobile parameters.
You must have the following requirements :

- Radio-communication tester
- M5 RF cable
- M5 Interface cable
- M4 / M5 Interface Box
- Serial Cable
- Computer under Windows 95 minimum (PII 350 MHz 64 Mb recommended)
- An ampermeter can be installed between the external supply and the interface box to check the mobile consumption.

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4.2 Basic Adjustment

Use MT Tools 2000 [1](Vers.103 Ed.02 or higher) to set all the parameters.

4.2.1 Power Adjustment

Each mobile is adjusted in the factory and the TX parameters (Power Control Level values and ramping values) are stored in the Flash Data (IC202)

About the adjustment value of TX Power, see the following table.

E-GSM				DCS		
Ch-62 PCL	**Power Level (dBm)**	**tolerance**		**Ch-698 PCL**	**Power Level (dBm)**	**tolerance**
5	33	+/-2dB		**0**	30	+/-2dB
6	31	+/-3dB		**1**	28	+/-3dB
7	29	+/-3dB		**2**	26	+/-3dB
8	27	+/-3dB		**3**	24	+/-3dB
9	25	+/-3dB		**4**	22	+/-3dB
10	23	+/-3dB		**5**	20	+/-3dB
11	21	+/-3dB		**6**	18	+/-3dB
12	19	+/-3dB		**7**	16	+/-3dB
13	17	+/-3dB		**8**	14	+/-3dB
14	15	+/-3dB		**9**	12	+/-4dB
15	13	+/-3dB		**10**	10	+/-4dB
16	11	+/-5dB		**11**	8	+/-4dB
17	9	+/-5dB		**12**	6	+/-4dB
18	7	+/-5dB		**13**	4	+/-4dB
19	5	+/-5dB		**14**	2	+/-5dB
				15	0	+/-5dB

4.2.2 RSSI control.

Set your radiocommunication tester at a given reference and check RSSI :

REF Gene	RSSI
-83.5 dBm	27 +/- 4
-60.5 dBm	50 +/- 4

[1] See Manual FA9M0640

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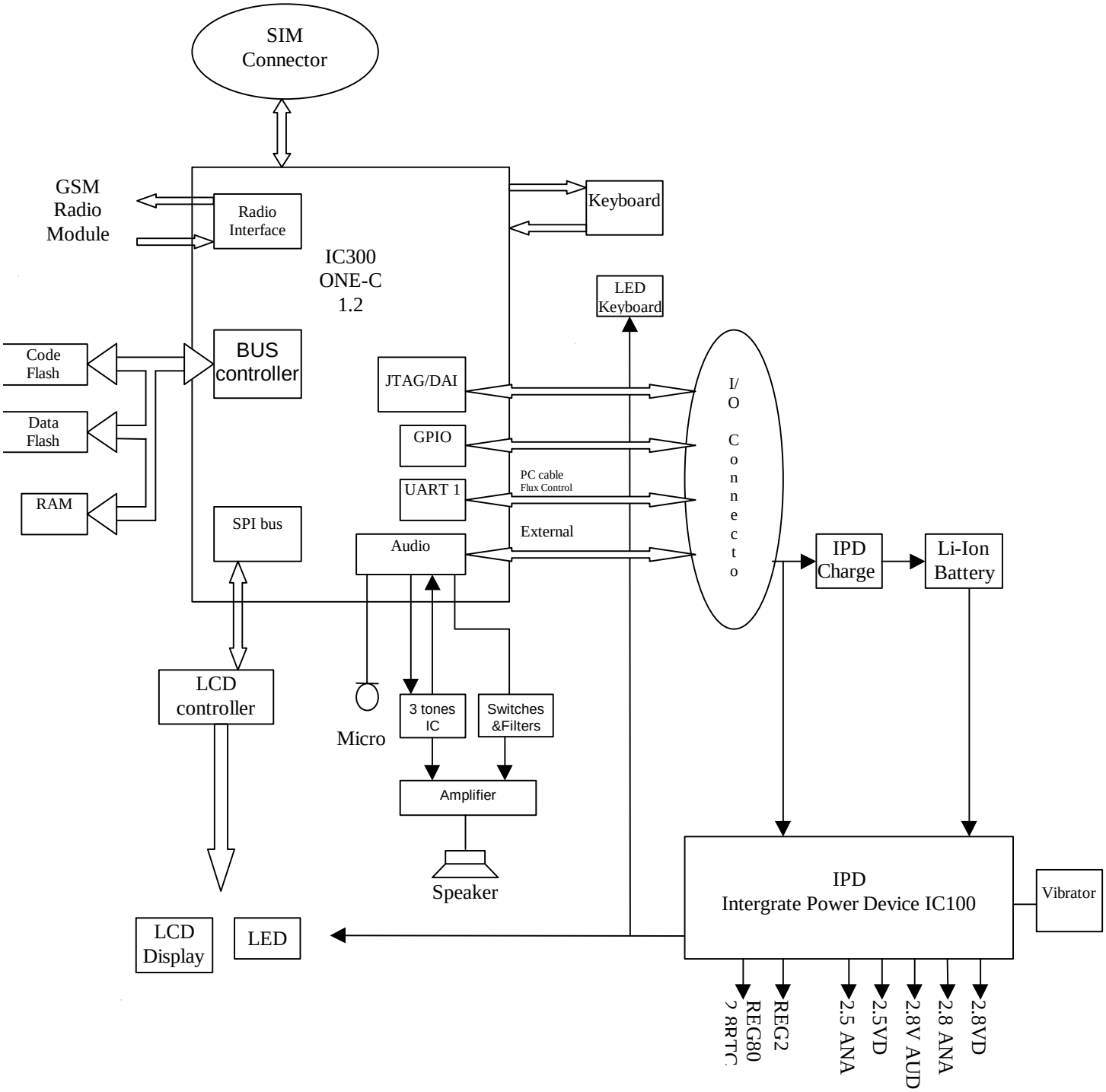
5 Block Diagram



6 Reporting file

The default and the results of the mobile repairing are saved in a data base using MT Tools and the normalized codes in order to achieve quality reports (see FA9M0640 & FA9M074410).

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7 Repair Logigrams (to be completed)

The repair logigrams are achieved after few mobile returns to the Mitsubishi's after sales service. Then these logigrams are delivered in FI instructions form to the repair centers via E-mail.

8 Trouble Shooting help guide

Defects observed	Measure/Investigation	Component no good correctives action
CHARGING PROBLEM *Charge consumption:* *Start around at 125mA, displays "Charging", fall over between 520 to 580mA with back light, then fall around 450 to 500mA.*		
Same consumption	Mobile consumption stay at 120mA	Check J101, soft upgrade, change TR112
Check Battery	Mobile displays "Check battery"	Change J103, Check J101
No charging	Visual check: connector J103 broken	J103
Incorrect Voltage	Mobile display "incorrect Voltage"	Check J103 & J101
Incorrect Voltage	Mobile display "incorrect Voltage" and J103 & J101 already changed	Check R126, TR103 TR112 & D117
Mitsubishi Testmode	Mobile displays "Mitsubishi testmode"	Change IC300
AUDIO PROBLEM		
Tone test no good	Check the multiactor connection	multiactor
Noisy reception	During a test call on network, audio reception defect	Micro, multiactor
Noisy reception	In a test call network; micro, receiver and speaker already changed	IC300
Noisy reception	Good in a test call network but noisy in a real call	IC300
Key sound	Key sound no good	Soft upgrade
DISPLAY PROBLEM		
Frozen LCD	A wave can be seen during the display	IC300
Incomplete display	Informations missing during the display	Change LCD or LCD connector
Backlight	Check the LEDs	Change the defected LEDs
White screen	Nothing displayed in normal mode and in testmode	Check J201 soldering Change J201 if broken or twisted change LCD
Inconsistent display	Character problems during the display	Change J201
Freezing display	The display stop during the On/Off process	Soft updating
No display	Mobile turn off when a key is pressed	Soft upgrade, change IC300
Wrong characters	Wrong characters on LCD	Soft upgrade
Error message	Enter lock code	Setting upgrade

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LOCATION UPDATE		
No service EGSM & DCS	TX & RX good in test mode	Soft updating
No service EGSM & DCS	After a soft updating still no good	IC300
No training sequence	Check VREF3, if parasite exist	Change C155, check C101
No training sequence	No modulation	IC401
RX level no good	With a –83db signal check the RSSI (= 27 ±4), RSSI good (10< <100) and the mobile lose the network	IC300
RX level no good	RSSI no good, RSSI > 100	IC300
RX level no good	RSSI no good, RSSI < 10	SW700
RX Qual > 2	RX qual no good	IC300
Call drop	Call stop at any time	Soft updating, IC300, IC401
POWER ON PROBLEM		
No power on	"Checksum error" during a software download (Keypad flashing)	Flash (IC200) defective (soldering)
No power on	Check the position of the key rubber	Replace the key rubber
No power on	Check J101 (batt connector) broken, missing Check the contact with the board	J101
No power on	Mobile turn on if the power key is pressed continuously, and switch off when the power key is released	IC300 (soldering)
Switch off itself	Mobile turn off itself	Soft updating, check J101
Normal consumption in TestMode : 20mA to 25mA		
DOWNLOAD PROBLEM		
Pb of downloading	Error during a software download	Retry , Change IC200, IC300
SIM PROBLEM		
Check SIM	Check the J301 soldering + contacts position	J301
Check SIM	Check the connecting between the SIM and the connector	Raise the SIM connector
BIT Error / PHASE Error		
Bit error/frame error	Compare RX demodulated signals (RXIN, RXIP, RXQP, RXQN) with a good mobile, if no good change one-C	IC300, IC401,SW700
Frequency error	Adjust the error frequency with MT Tools (mode repair – TCXO), still no good change IC401	IC401, 13MHz, IC300,IC600
Phase error	Pb of modulation	IC401, IC600, X600

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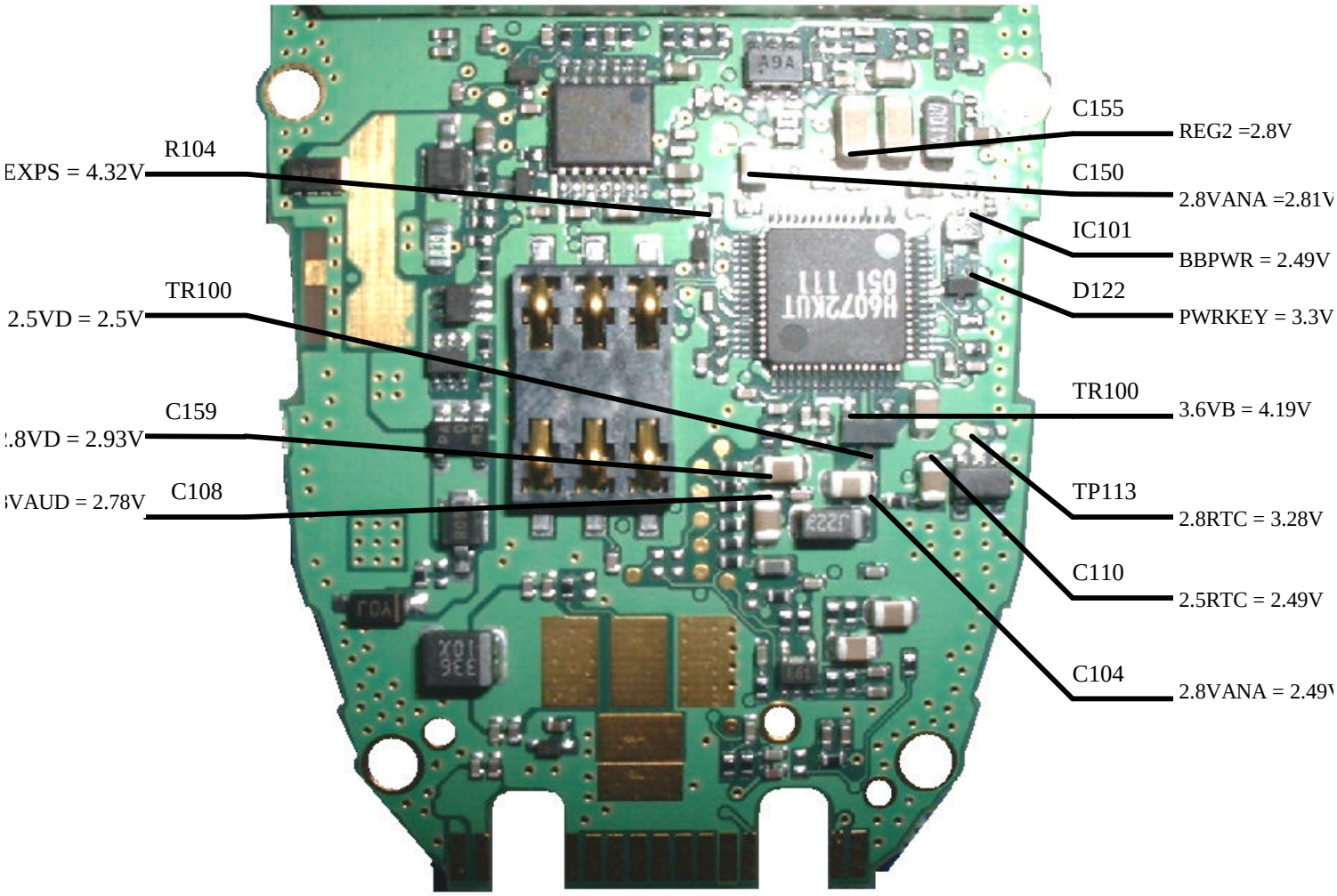
9 Hardware description

9.1 Power management

9.1.1 Power Supply

Initial conditions:



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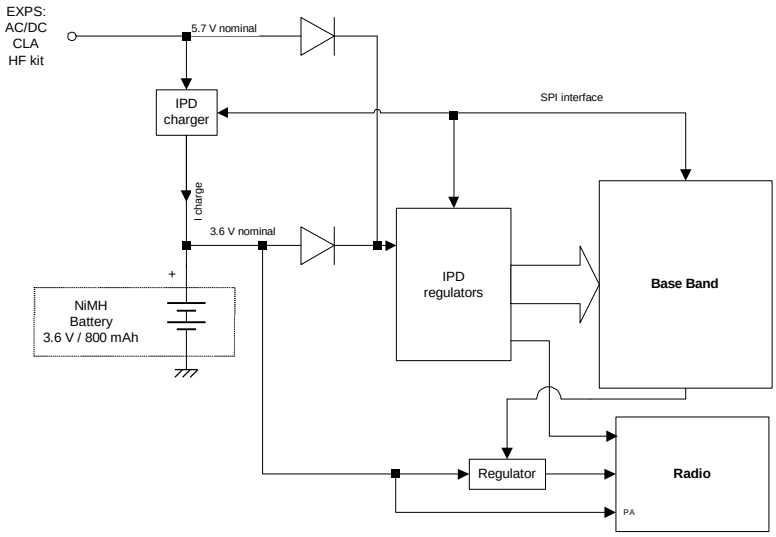
9.1.2 Battery management

9.1.2.1 Block Diagram / Description

Regarding the CUPID, the battery is Li-Ion 800 mAh, 3.8 V, whereas the external power supply is 5.7 V, 600 mA nominal.



When an external power supply is plugged, the voltage of **EXPS**[2] is 5.7 V, therefore battery does not supply anymore the Base Band (via IPD regulators). Indeed, the voltage from the **EXPS** is always greater than the one from battery, the diode D100 is no more opened.

Nevertheless, some parts of the radio are only supplied by the battery.

Battery presence is accessible in CHGM IPD register. The battery level information is accessible in an A/D converter in One-C. It is also available in CHGM IPD register, these information are given by range only for range control.

The battery temperature information (TH) is given by thresholds in IPD CHGM register. This information are used only for charge control.

Bypass is Activated when battery is less than 3.45 V.

The regulator IC103 is to make the power supply 2.5RTC for the One C.

9.1.2.2 Charging process

The IPD charger, supplied by EXPS achieves the charge. The charge process is done by an internal algorithm controlled by S/W.

The 1C current charge is fixed by hardware to 420 mA, so that a complete charge duration is about 130 min at room temperature.

Charging process follows these successive phases:

1. **Pre charge**:
   This phase is mandatory before the rapid charge to verify that battery operation is normal (normal battery voltage and temperature). Charge current during this phase is 52 mA ($\frac{1}{8}$ C). If the battery voltage is higher than 3.4 Volts, the S/W launches IPD charger **in Rapid charge** except if the temperature is not between 0°C and 55°C.

2. **Rapid charge**:
   Charge current during this phase is 420mA. If battery temperature becomes abnormal IPD charger start at low current charge $\left(\frac{1}{20}\mathrm{C}\right)$, while temperature comes back normal (between 0°C and +55°C) during 15 min.

   Full charge detection ends Rapid charge. Full charge is detected by S/W when one out of the three evens occurs:

- Battery voltage begins to decrease $\left(-\Delta \mathrm{V}\right)$
- Battery voltage stops to increase during 20 min $\left(\overline{\Delta \mathrm{V}}\right)$
- Rapid charge time is expired (150 min)

[2] **Ex**ternal **P**ower **S**upply

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3. **Trickle mode**:

This phase is necessary to complete the charge and to avoid battery auto discharge. Charge current during this phase is $\frac{1}{20}C$.

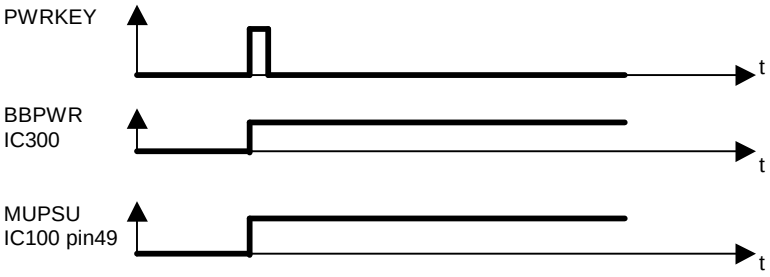
Trickle charge is automatically stopped after 24 hours duration.

9.1.3 Power on/off

9.1.3.1 Power on

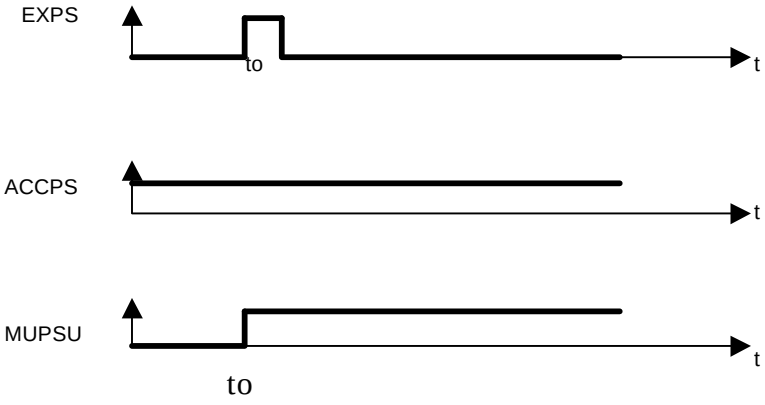
To switch on the mobile, three possibilities exist :

With a battery :



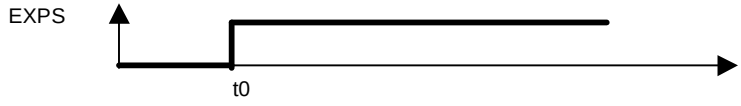
During these mode TESTPS and EXPS = low voltage level.
A high voltage level on MUPSU implies regulators REG 2, REG 3, REG 4, REG 5, REG 6, REG 7 are active.

- With Interface and I/O connector (Testmode M.T.S) :



t0 is the time when the “mobile on” button on the interface has been pushed.

- With AC/DC Charger, Cigar Light Adapter and DeskTop Charger.



t0= connection by external power.

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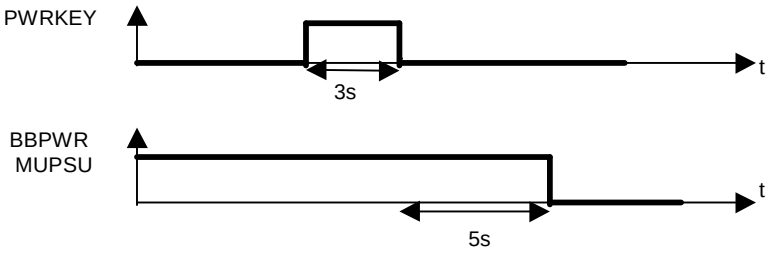
9.1.3.2 Power off.



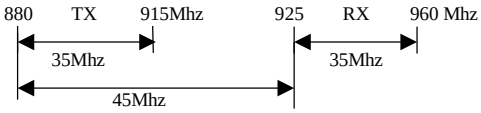
10 RF Section.

10.1 Frequency range.

10.1.1 E-GSM Frequency :

124 Channels. 1≤ N ≤124 and 48 Channels. 975 ≤ N ≤1023
Receive frequency: 925.2~959.8 MHz
RX frequency = 935.0+0.2*N for (1≤ N ≤124) and 935.0+0.2*(N-1024) for (975 ≤ N ≤1023)
Transmit frequency : 880.2~914.8 MHz
TX frequency = 890.0+0.2*N for (1≤ N ≤124) and 890.0+0.2*(N-1024) for (975≤ N ≤1023)

E-GSM BAND



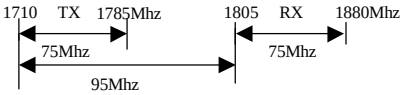
RF-PLL E-GSM BAND

RX IF is 360MHz

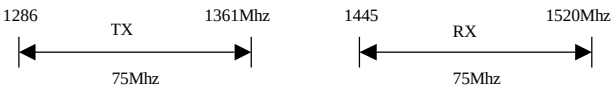
10.1.2 DCS Frequency :

374 Channels. 512≤ N ≤885
Receive frequency: 1805.2~1879.2 MHz
RX frequency = 1805.2+0.2*(N-512).
Transmit frequency 1710.2~1784.8 MHz
TX frequency = 1710.2+0.2*(N-512).

DCS BAND



RF-PLL DCS BAND



RX IF is 360MHz

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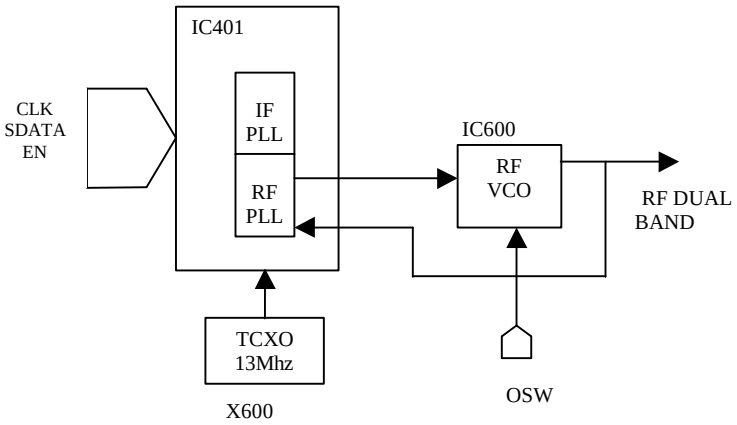
10.2 Synthetiser Circuit Description.



Switching between GSM and DCS band is performed by programming the IC401 with the serial data in BBE from CPU.
The serial data lines are connected directly to the serial input pin of the RF IC (IC 401), and are used to program the 2 PLLs of the IC.

The RF IC has two PLLs : one is variable frequency (RF PLL), and the other is fixed frequency (IF PLL).

RF-PLL : variable frequency PLL for RX and TX for both GSM and DCS bands.
Oscillation Frequency Ranges :
- For E-GSM Band / 1150 - 1185MHz
- For DCS TX / 1575 - 1650MHz
- For DCS RX / 1580 - 1655MHz

IF-PLL : Fixed frequency 424 MHz for IF of TX for both E-GSM and DCS bands.
Fixed frequency 360 MHz for IF of RX for both E-GSM and DCS bands.
The signal BANDSW controls the E-GSM/DCS Band switching.

BANDSW	RF BAND
0	E-GSM
1	DCS

In order to achieve the channel spacing, the reference frequency is set to 200 kHz.

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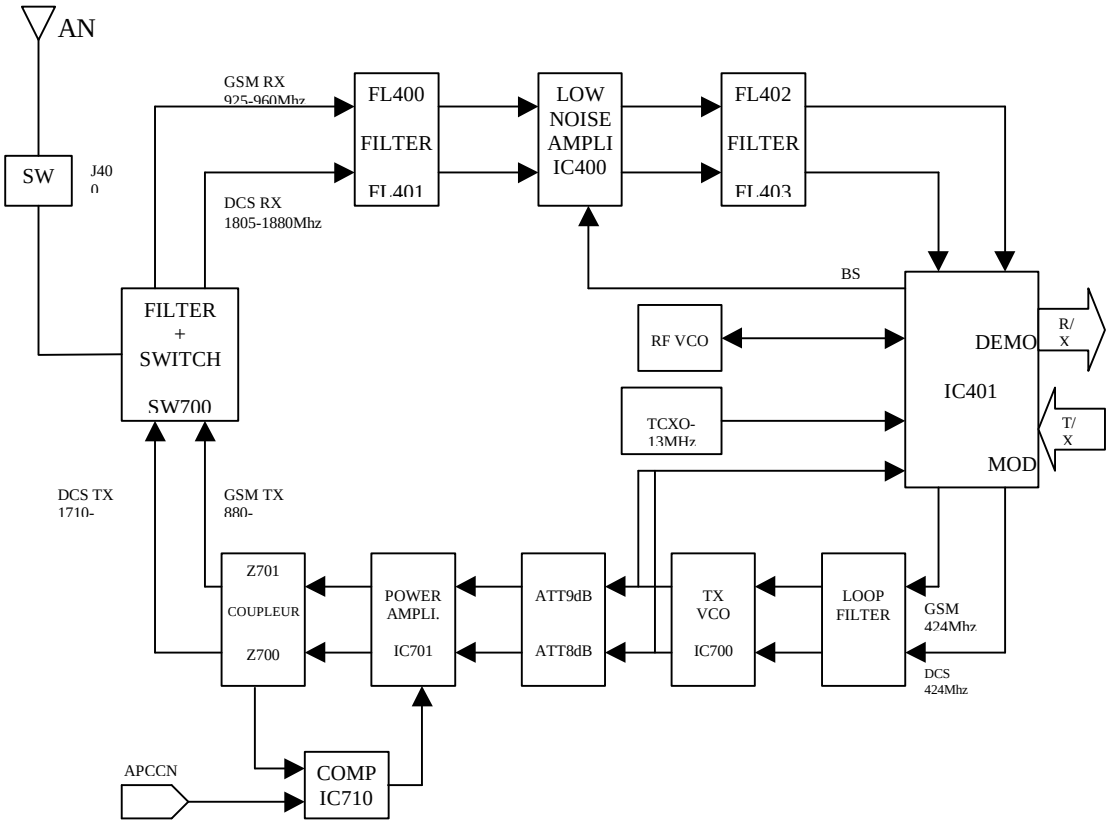
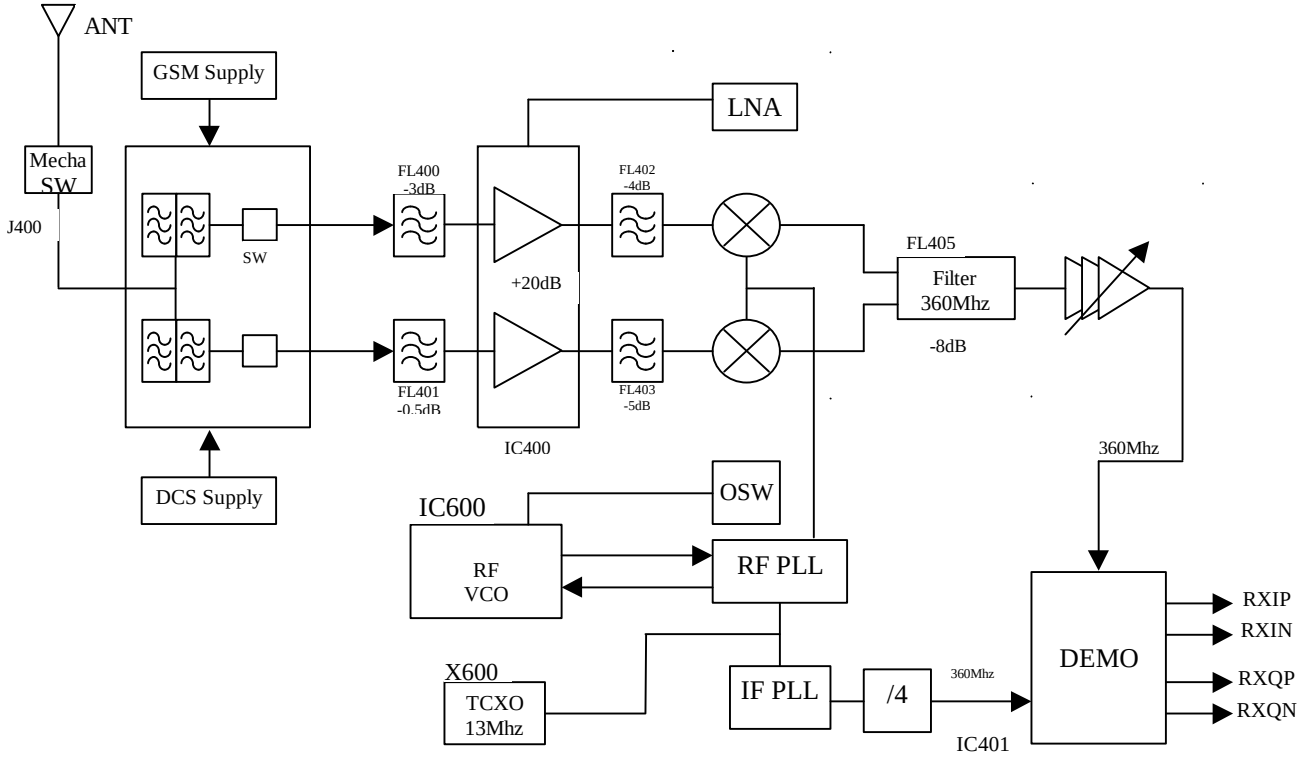
10.3 RF Block Diagram.



10.4 Reception

10.4.1 Reception Block Diagram.



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10.4.2 Description of Reception Block Diagram

E-GSM band (925-960MHz).

Incoming RF signal from aerial is filtered and switched to the RX GSM path through SW700 . The signal is filtered by FL400 , before to be amplified by IC400 , and is further filtered by FL402. Then, the RF signal (925-960 MHz) is mixed with a frequency (1150-1185 MHz) coming from the RF-PLL and controlled by the RF-VCO (IC602). For the channel 1, the output signal of the mixer is 360 MHz (1285 MHz-925 MHz =360 MHz), and is filtered by FL405.

DSC band (1805-1880MHz).

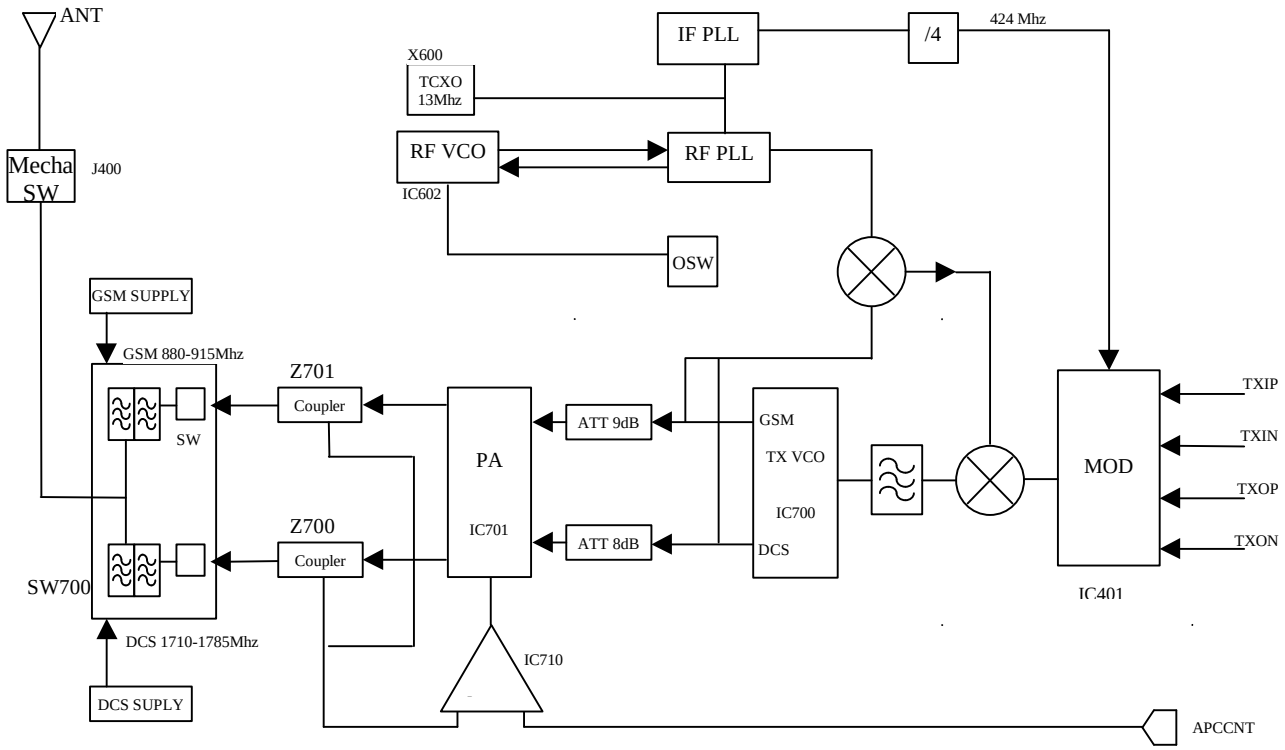
Incoming RF signal from aerial is filtered and is switched to the RX DCS path through SW700 . The signal is filtered by FL401 , before to be amplified by IC400 , and is further filtered by FL403. Then, the RF signal (1805-1880 MHz) is mixed with a frequency (1445-1520MHz)coming from the RF-PLL and controlled by the RF-VCO (IC602). For the channel 1, the output signal of the mixer is 360 MHz (1805 MHz-1805 MHz =360 MHz), and is filtered by FL405.

For the E-GSM and DCS bands.

The single intermediate frequency is 360 MHz. Then, these frequency is filtered by FL 405.The IF is demodulated to Base Band (IC300) I/Q phase demodulated signals. RF-IC (IC401) provides automatic gain control.
IC401 includes a quadrature demodulator using a divide by four technique for 90° phase splitter. The IF signal (360 MHz) is demodulated to I, Q balanced signals for BBE.

10.5 Transmission.

10.5.1 Transmission Block Diagram.



10.5.2 Description of Transmission Block Diagram.

The direct and phase shifted signals are then fed to I and Q modulators inside the IC401. I and Q data components are fed into the IC401. The output from the two modulators is summed and fed out of pin 25. The GMSK signal leaves the modulator of IC401.

E-GSM Band (880-915MHz).

A phase locked loop is created around the TXVCO IC700. The output is fed into IC401 and converted to 424 MHz by mixing with RFVCO at 1304-1339 MHz. This 424 MHz signal is compared with the 424MHz signal from the modulators, and the error signal is used to control the TXVCO. Note that the error signal on the IC700 input will have a DC component to control frequency, and an AC component at approx 424 MHz to control phase changes. Then the signal is filtered, attenuated by a filter allowing an impedance adaptation with the power amplifier IC701. From the PA, the output goes through coupler Z701, is switched to the TX path and is filtered by SW700. The signal then goes up to the antenna.

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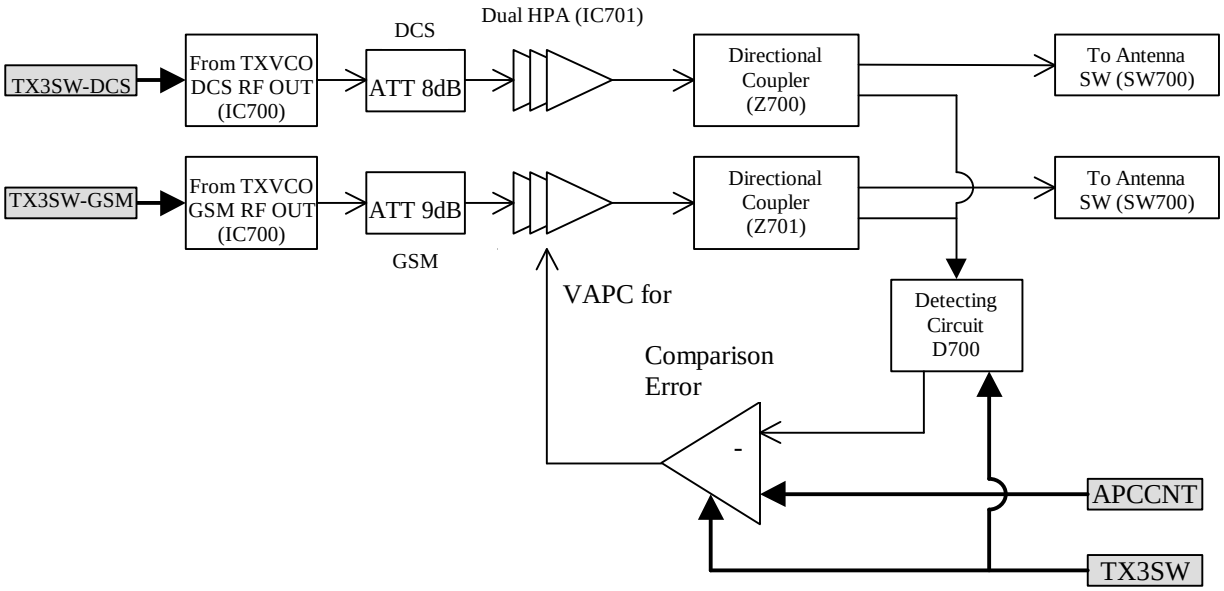
DCS Band (1710-1785MHz).

A phase locked loop is created around the TXVCO IC700. The output is fed into IC401 and converted to 424 MHz by mixing with RFVCO at 1286-1361 MHz. This 424 MHz signal is compared with the 424MHz signal from the modulators, and the error signal is used to control the TXVCO. Note that the error signal on the IC700 input will have a DC component to control frequency, and an AC component at approx 424 MHz to control phase changes. Then the signal is filtered, attenuated by a filter allowing an impedance adaptation with the power amplifier IC701. From the PA, the output goes through coupler Z 700, is switched to the TX path and is filtered by SW700. The signal then goes up to the antenna.

10.5.3 Power Control.



APCCNT is the reference waveform voltage for a TX burst (provided by IC300).

TX3SW-DCS : This control signal is used to switch on/off the DCS path through the TXVCO (IC700)
H.Level : The DCS part inside the TXVCO is active.
L.Level : The DCS part inside the TXVCO is not active.

TX3SW-GSM : This control signal is used to switch on/off the GSM path through the TXVCO (IC700)
H.Level : The GSM part inside the TXVCO is active.
L.Level : The GSM part inside the TXVCO is not active.

TX3SW :This control signal is used to switch on/off the operational amplifier of the APC Loop (IC710).
H. Level : Detecting Circuit and comparison Error AMP is active.
L. Level : Detecting Circuit and comparison Error AMP is not active.

RF signal is rectified by voltage doubler Schottky barrier diodes D700. This level is compared with APCCNT. The result of the comparison is used to vary the gain of the HPA IC701.
The APCCNT signal input from the base band circuit (IC300) contains the burst shaping information and the power level to be set among the 15 power levels defined by the GSM, or the 16 power levels defined by the DCS specifications. It controls the output power level by a feed-back loop (Automatic Power Control).

E-GSM	DCS
PCL 5 → +33 dBm	PCL 0 → +30 dBm
PCL 19 → +5 dBm	PCL15 → +0 dBm

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11 Personal Notes

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