Chapter 1

System Module GM8

Original 08/97

CHAPTER 4 – SYSTEM MODULE GM8

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Introduction

System Module GM8 is the baseband/RF module NME–2A cellular tranceiver. The GM8 module carries out all the system and RF functions of the tranceiver. System module GM8 is designed for a mobile phone, that operate in GSM system.

Technical Specifications

The entire transceiver is built on a single multilayer PCB. This board is enclosed in a housing consisting of a metal bottom part and a metallized top plastic part. The housing has walls to separate baseband from RF.

Modes of Operation

There are three different operation modes:

– active mode

– idle mode

– power off mode

In the active state all circuits are powered and part of the module may be in idle mode.

The module is usually in the idle mode when there is no call and the phone is in SERV. In the idle mode circuits are reset, powered down and clocks are stopped or the frequency reduced. All the clocks except the main clock from VCTCXO can be stopped in that mode. Whether the SIM clock is stopped or not depends on the network.

Currently the MCU only goes into sleep mode when in IDLE, not to MCU standby mode as the time to wake the SW is too long.

In power off mode all circuits are disabled. Power is turned on and off by pressing the *on/off* key on the handset which activates a power FET on the transceiver. The power FET enables power to the handset and the transceiver.

The Ignition Sense circuit will (when connected) turn the phone on when IGNS input goes high. This circuit is active for approximately 200ms. which is ample time for the phone to turn on.

External and Internal Connections

The transceiver has three connectors, a 25 pole connector which basically implements the VDA recommendation for a GSM mobile phone, the antenna connector and a 16 pole connector for the Data Transfer implementing the M2BUS, the D–BUS and Flash programming. All internal connections on the board are by PCB wiring. The SIM card reader is soldered to the board.

System Connector

Pin:	Name:	Description:
1	MIC	Handset mic
2	NC	Not used
3, 17	RFGND	Battery GND
4, 16	VBATT	Battery voltage • nominal voltage: *13.2 V*
5	IGNS	IGNS input • when IGNS goes from low to high voltage the radio will be turned on
6	EAR	Earphone signal • signal to handset pin 8
7	NC	No connection
8	RFGND	Handset ground • handset connector pin 2
9	AUTO ANTENNA	Antenna control • phone off: *0...0.3 V* • phone on: *VBATT* • min ext load: *80 Ω* • I_{MAX}: *200 mA*
10	CRM	CRM car radio mute • during a call: *0...0.3 V* • standby mode: *VBATT* • min ext load: *80 Ω* • I_{MAX}: *200 mA*
11	MBUS	M2BUS • handset pin 3, in parallel with pin 5 of data connector
12	NC	Not connected
13	NC	Not connected

Pin:	Name:	Description:
14	RFGND	HF Mic ground
15	MIC_HF	External HF microphone
18	XPWRON	Power on/off control • input low: *0...0.2...0.7 V* • connected to switch transistor pulled high to VBATT
19	LSP	Audio to HF/handset speaker • impedance min: *3 Ω* • power max: *4 W*
20	Shield GND	Shielding
21	NC	Not connected
22	NC	Not connected
23	VBSW_1	Switched VBATT supply for handset • for HS pin 1 • value: *10.8...13.2...15.6 V*
24	AGND	Analog GND
25	LSPGND	HF speaker ground

SIM Card Reader

Pin	Symbol:	Description:	Values:
1	GND	Ground	
2, 6	VSIM	SIM card reader supply voltage • voltage:	*4.5...4.65...4.8 V*
3	SIMDATA	Data for SIM card • state ”1”: • state ”0”:	*3.6...4.65...4.8 V* *0...0.2...0.7V*
4	SIMCLK	Clock for SIM card • state ”1”: • state ”0”:	*3.6...4.65...4.8 V* *0...0.2...0.7 V*
5	SIMRESET	Reset for SIM card • output high: • output low:	*3.6...4.65...4.8 V* *0...0.2...0.7V*
7	CARDDET	Signal to ASIC • card not present: • card present:	*3.6...4.65...4.8 V* *0...0.2...0.7V*

Data Connector

Pin:	Name:	Description	Value
1, 9	DGND	Digital ground	
2	MMODE	Minimum mode, input line Connect to DGND for normal operation. Connect to M2BUS before power–on when flash programming.	
3	AGND	Analog ground	
4	TDA	Transmitted DBUS data to the data card. • state ”1”: • state ”0”:	 *3.6...4.65...4.8 V* *0...0.2...0.7 V*
5	M2BUS	Serial bidirectional data and control between the phone and accessories.	
6	RXD2	Flash loading data from programmer • input low level: • input high level:	 *0...0.2...0.7 V* *3.6...4.65...4.8 V*
7	TXD2	Flash acknowledge data to programmer • output low level: • output high level:	 *0...0.2...0.7 V* *3.6...4.65...4.8 V*
8, 16	NC	No connection	
10	NC	No connection	
11	DSYNC	DBUS data bit sync 8 kHz clock. • high level: • low level:	 *3.6...4.65...4.8 V* *0...0.2...0.7 V*
12	RDA	DBUS received data from data card. • state ”1”: • state ”0”:	 *3.6...4.65...4.8 V* *0...0.2...0.7 V*
13	NC	Not used.	
14	VF	Programming voltage for flash. • value:	 *11.4...12...12.6 V*
15	DCLK	DBUS data 512 kHz clock. • state ”1”: • state ”0”:	 *3.6...4.65...4.8 V* *0...0.2...0.7 V*

Internal Signals

Symbol:	Description:	Values:
SCLK	Synthesizer clock	
	• load impedance:	*10 kΩ*
	• frequency:	*3.25 MHz*
SDATA	Synthesizer data	
	• load impedance:	*10 kΩ*
	• data rate frequency:	*3.25 MHz*
SENAR	Synthesizer enable	
	• PLL contr. disabled:	*4.5...4.65...4.8 V*
	• PLL activated:	*0...0.2...0.7 V*
	• current:	*50 µA*
SENAT	Synthesizer enable	
	• PLL contr. disabled:	*4.5...4.65...4.8 V*
	• PLL activated:	*0...0.2...0.7 V*
	• current:	*50 µA*
RXPWR	RX supply voltage on/off	
	• RX supply voltage on:	*4.5...4.65...4.8 V*
	• RX supply voltage off:	*0...0.2...0.7 V*
	• current:	*0.5 mA*
SYNTHPWR	Supply voltage on/off	
	• RF regulators on:	*4.5...4.65...4.8 V*
	• RF regulators off:	*0...0.2...0.7 V*
	• current:	*1.0 mA*
TXPWR	TX supply voltage on/off	
	• TX supply voltage on:	*4.5...4.65...4.8 V*
	• TX supply voltage off:	*0...0.2...0.7 V*
	• current:	*0.5 mA*
TXP	TX enable	
	• transmitter power enable:	*4.5...4.65...4.8 V*
	• transmitter power disable:	*0...0.2...0.7 V*
AFC	Automatic frequency control voltage	
	• voltage min/max:	*0.35...4.35 V*
	• resolution:	*11 bits*
	• load impedance (dynamic):	*10 kΩ*
TXC	TX transmit power control voltage	
	• voltage range min/max:	*0.3...4.2 V*
	• impedance:	*10 kΩ*

Addendum to the Technical Documentation for NME–2A:

Chapter 4: Technical Specification System Module GM8S.

Internal Signal page 4–9: New signals

PA_CO Power amplifier supply compensation

*Load Impedance 1k2 ohm

*DC range (VBATT Supply Switched on) 15.6–10.2 Vdc

PA_ADJ Power control loop DC–ADJ

*Voltage range 0.3...4.6 Vdc

*Load Impedance 10k ohm

Symbol:	Description:	Values:
TXQP,TXQN	Differential TX quadrature signal	
	• differential voltage swing:	*1.15...1.2...1.25 V_{PP}*
	• d.c. level:	*2.30...2.35...2.40 V*
	• load impedance:	*30 kΩ*
TXIP,TXIN	Differential TX in phase signal	
	• differential voltage swing:	*1.15...1.2...1.25 V_{PP}*
	• d.c. level:	*2.30...2.35...2.40 V*
	• load impedance:	*30 kΩ*
PDATA0–5	Parallel AGC data	
	• reduced front end gain:	*4.5...4.65...4.8 V*
	• normal front end gain:	*0...0.2...0.7 V*
	• current:	*0.1 mA*
	• PDATA1; AGC 3 dB reduction	
	• PDATA2; AGC 6 dB reduction	
	• PDATA3; AGC 12 dB reduction	
	• PDATA4; AGC 24 dB reduction	
	• PDATA5; AGC 12 dB reduction	
RXQ	RX quadrature signal	
	• output level:	*15 mV_{PP}*
	• source impedance:	*470 Ω*
RXI	RX in phase signal	
	• output level:	*15 mV_{PP}*
	• source impedance:	*470 Ω*
RFC	High stability clock signal for the logic circuits	
	• frequency:	*26 MHz*
	• signal amplitude:	*1.0 V_{PP}*
	• load resistance:	*10 kΩ*
VREF	VCTCXO supply voltage	
	• voltage:	*4.55...4.65...4.75 V*
	• current:	*2.0 mA*
VBATT_RF	Supply voltage for RF	
	• voltage:	*10.8...13.2...15.6 V*
VBATT_I	Supply voltage for the PA module	
	• voltage:	*10.8...13.2...15.6 V*
6V5_RF	Supply voltage for 5 V regulators	
	• voltage:	*6.0...6.5...7.0 V*

Symbol:	Description:	Values:
8V5_RX_TX	Supply voltage for BB	
	• voltage:	*7.5...8.3...8.7 V*
VAI	8.5 V regulator on/off	
	• logic high ”1”:	*4.7 V*
	• logic low ”0”:	*0 V*

Baseband Block Description

General

The purpose of the baseband module is to control the phone, to process audio signals to and from the RF block and to and from the handset/ handsfree transducers. The module also includes a SIM card reader and furnishes external data and control lines.

Names of Functional Blocks

Name:	Function:
CTRLU	Control unit for phone
PWRU	Power supply
DSPU	Digital signal processing block
AUDIO	Audio coding
ASIC	D2CA GSM/PCN system ASIC; several functions
RFI	RF baseband interface

Clocking Scheme

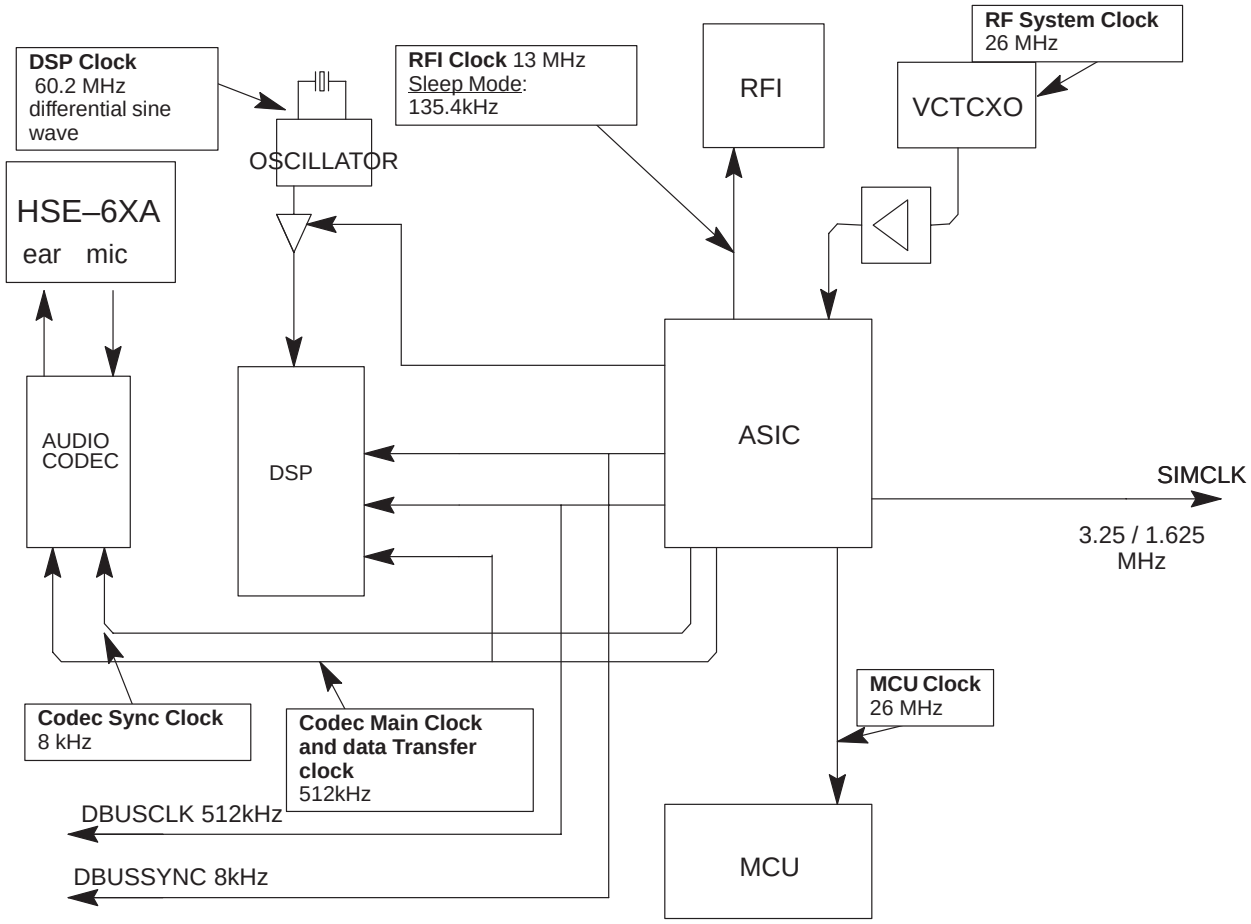

Figure 1. Clocking Scheme

Most of the clocks are generated from the 26 MHz VCTCXO frequency by the ASIC:

- 26 MHz clock for the MCU. MCU‘s internal clock frequency is half of that.
- 13 MHz for the RFI.
- The ASIC also generates 135.4 kHz sleep mode clock for the RFI
- 3.25 MHz clock for SIM. When there is no data transfer between the SIM card and the phone the clock can be reduced to 1.625 MHz. Some SIM cards also allows the clock to be stopped in that mode.
- 512 kHz main clock for the codec and for the data transfer between the DSP and the codec.
- 8 kHz synchronization clock for data transfer between the DSP and the codec.
- 512 kHz clock and 8 kHz sync. clock for the DBUS data transfer.

The DSP has its own crystal oscillator. The DSP uses differential sinusoidal clock. The frequency is 60.2 MHz. The DSP clock buffer can be powered down via ASIC. The ASIC MCU generates 8 kHz clock to the codec for the control data transfer.

In the idle mode all the clocks can be stopped except 26 MHz main clock coming from the VCTCXO. The VCTCXO signal is buffered to limit frequency pulling caused by the baseband circuits.

Reset and Power Control

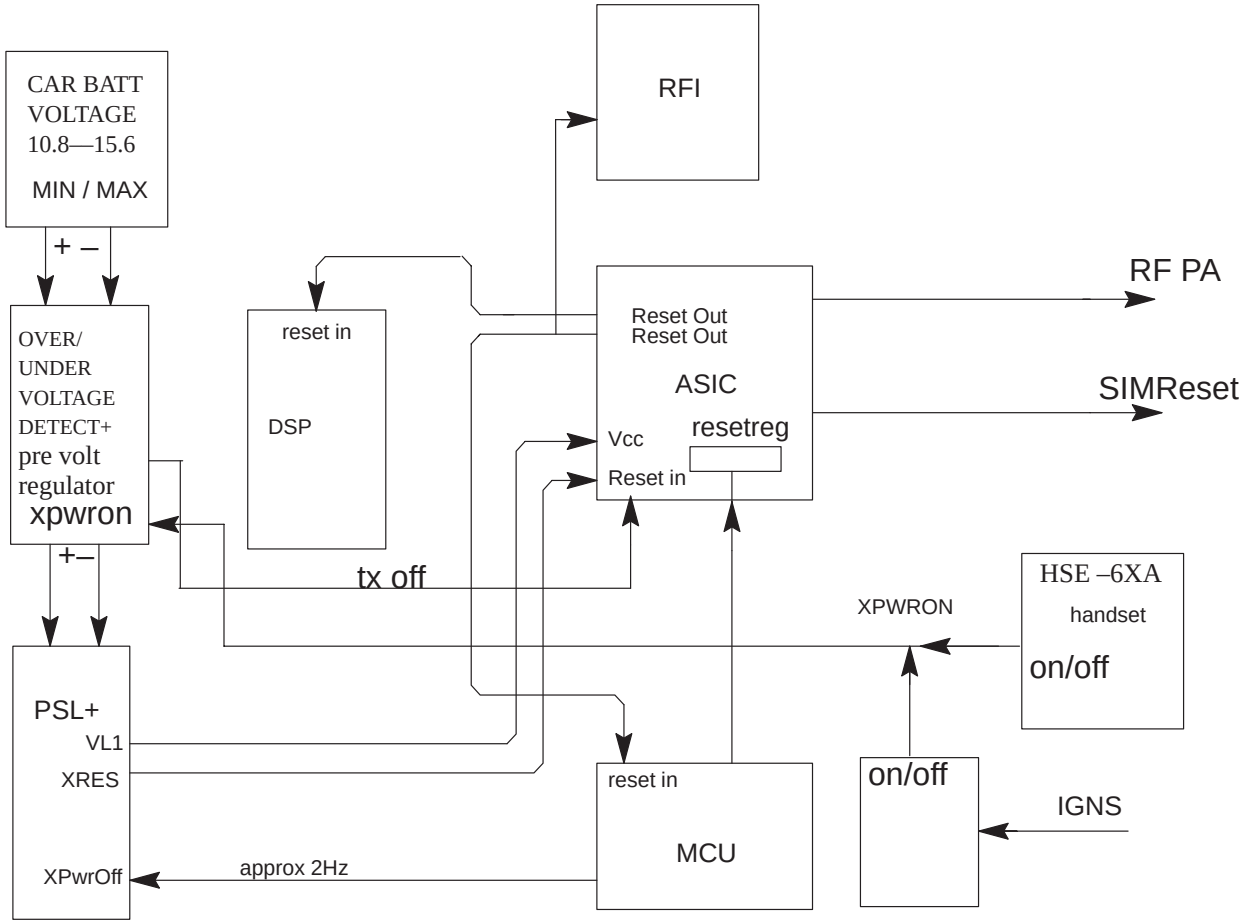

Figure 2. Reset & Power Control

There are two different ways to switch power on:

– Pushing the on/off button of the handset the effect of which is to ground the input pin XPWRON of the System Connector or

– Pulling the input IGNS high.

All devices are powered up at the same time. The PSL+ supplies the reset to the ASIC at power up. The ASIC start delivering clock signals the to the DSP and the MCU. After about 20 µs the ASIC releases the resets to MCU, RFI and DSP. MCU and RFI reset is released after 256 13 MHz clock cycles. DSP reset release time from DSP clock activation can be selected from 0 to 255 13MHz clock cycles. In our case it is 255. SIM reset release time is according to GSM SIM specifications.

To turn off power for the phone, the user presses the on/off key (or turns off the ignition key of the car). The MCU detects this. The MCU cuts off any ongoing call, exits all tasks, acts inoperative to the user and stops the PSL+ watchdog without resets. After power–down delay, the PSL+ cuts off the supply from all circuitry.

When the IGNS line is connected the phone will turn on when this line goes high. The IGNS circuit pulls the XPWRON low for a approx. 200 msec as if the handset on/off button was being pushed.

The power may be turned off by sending a turn off command on the M2BUS from handset or through the Data Connector.

In the User Interface SW an automatic shutdown feature will be implemented. When no activity have been observed for a user settable period. the phone will turn off thus limiting the risk of draining the car battery.

Watchdog System

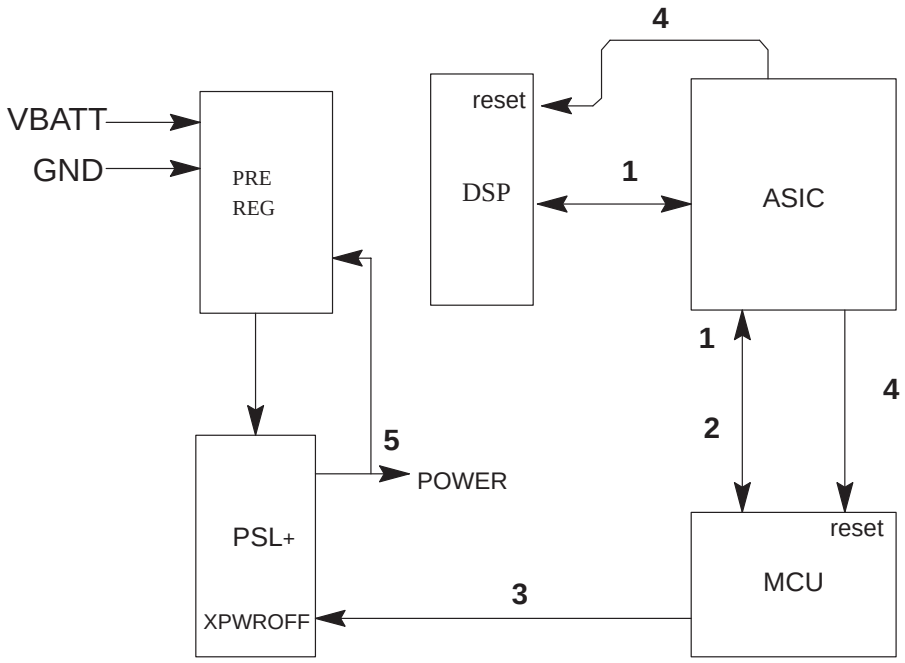

Figure 3. Watchdog System

Normal operation:

– 1. MCU tests DSP
– 2. MCU updates ASIC watchdog timer (> 2 Hz)
– 3. MCU pulses the XPWROFF input on the PSL+ (about 2 Hz)

Failed operation:

– 4. ASIC resets MCU and DSP after about 0.5 s failure
– 5. PSL+ switches power off about 1.5 s after the previous XPWROFF pulse

CTRLU

The Control block contains a microcomputer unit (MCU) and three memory circuits (FLASH, SRAM, EEPROM), a 20–bit address bus and an 8–bit data bus.

Main Features of the CTRLU Block

MCU functions:

– system control
– communication control
– handset interface functions
– authentication
– RF monitoring
– power up/down control
– self–test and production testing
– flash loading

Main Components

– Hitachi H8/536

  H8/536 is a CMOS microcomputer unit (MCU) comprising a CPU core and on–chip supporting modules with 16–bit architecture. The data bus to outside world has 8 bits.

– 1024k*8bit FLASH memory

  100 ns maximum read access time

  contains the main program code for the MCU; part of the DSP program code also located on FLASH

  ASIC can address two 4 Mbit memories or one 8 Mbit memory.

– 32k*8bit SRAM memory

  100 ns maximum read access time

– 8k*8bit EEPROM memory

150 ns maximum read access time

contains user defined information

there is a register bit on the ASIC which must be set before the write operation to the EEPROM.

Input Signals of CTRLU

Name(from):	Description:
VL1(PWRU)	Power supply voltage for CTRLU block
VREF(PWRU)	Reference voltage for MCU A/D converter
EROMSELX(ASIC)	Chip select for the EEPROM memory
ROMSELX(ASIC)	Chip select for the FLASH memory
ROMAD18(ASIC)	Chip select for the FLASH memory (FLASH1)
RAMSELX(ASIC)	Chip select for the SRAM memory
RESETX(ASIC)	Reset signal for MCU
NMI(ASIC)	Non–maskable interrupt request
MCUCLK(ASIC)	Main clock for MCU
IRQX(ASIC)	Interrupt request
PCMCDO(AUDIO)	Audio codec control data receiving
TRF(RF)	RF module temperature detection
VF(data conn.)	Programming voltage for FLASH memory
RXD2 (data conn.)	The use of handsfree monitoring FLASH programming data input on the production line
MMODE	Minimum mode for FLASH programming

Output Signals of CTRLU

Name(to):	Description:
XPWROFF(PWRU)	Power off control, PSL+ watchdog reset
WSTROBEX(ASIC)	MCU write strobe
RSTROBEX(ASIC)	MCU read strobe
MCUAD(19:0)(ASIC)	20 bit MCU address bus
MBUSDET(ASIC)	MBUS activity detection
PCMCLK(AUDIO)	Clock for audio cedec control data transfer
PCMCDI(AUDIO)	Audio codec control data transmitting
XSELPCMC(AUDIO)	Chip select for audio codec
TXD2 (data connector)	Verification output of the programmed data of FLASH during programming

Bidirectional Signals of CTRLU

Name(to/from):	Description:
MCUDA(7;0)(ASIC)	MCU’s 8 bit data bus
M2BUS	Asynchronous serial data bus

Block Description

– MCU – memories

The MCU has a 20 bits wide address bus A(19:0) and an 8–bit data bus with memories. The address bits A(19:16) are used for chip select decoding. The decoding is done in the ESA ASIC. The ASIC can address two 4 Mbit (or smaller) or one 8 Mbit flash memories. Hitachi HD647536 processor has internal ROM and RAM memories.

– Flash programming

In flash programming a special flash programming box and a PC is needed. Loading is done through the 16 pole Data Connector of the mobile phone. First MCU goes to minimum mode (MBUS command from PC or if MBUS is connected to MMODE line during power up). Then the flash software is loaded from PC to flash loading box. When the loading is complete, flash loading to mobile can be started by MBUS command from PC to the MCU. After that the MCU asks the test box to start flash loading to mobile. The box supplies 12 V programming voltage for flash and starts to send 250 bytes data blocks to the MCU via RXD2 line. The baud rate is 406 kbit/s. The MCU calculates the check sum,

sends acknowledge via TXD2 line and sends the data to flash. When all the data are loaded the mobile resets and tells the flash loading box if the loading was successful or not.

– CTRLU – PWRU

MCU controls the watchdog timer in PSL+. It sends a positive pulse at a rate of approximately 2 Hz to XPWROFF pin of the PSL+ to keep the power on. If MCU fails to deliver this pulse, the PSL+ will remove power from the system. When power off is requested by the user or by the MCU SW, (UI SW or CS SW), the MCU leaves the PSL+ watchdog without reset pulses. After the watchdog time has elapsed the PSL+ cuts off the supply voltages from the phone.

– CTRLU – ASIC

MCU and ASIC have a common 8–bit data bus and a 9–bit address bus. Bits A(4:0) are used for normal addressing whereas bits A(19:16) are decoded in ASIC to chip select inputs for CTRLU memories. ASIC controls the main clock, main reset and interrupts to MCU. The internal clock of MCU is half the MCUCLK clock speed. RESETX (produced by ASIC) resets everything in MCU except the contents of the RAM. IRQX is a general purpose interrupt request line from ASIC. After IRQX request the interrupt register of the ASIC is read to find out the reason for interrupt. NMI interrupt is used only to wake up MCU from software standby mode.

– CTRLU – DSPU

MCU and DSP communicate through the ASIC. ASIC has an MCU mailbox and a DSP mailbox. MCU writes data to DSP mailbox where DSP can only read the incoming data. In MCU mailbox the data transfer direction is the opposite. When power is switched on the MCU loads data from the Flash memory to the DSP‘s external program memory through this mailbox.

– CTRLU – AUDIO

When the the chip select signal XSELPCMC goes low, MCU writes or reads control data to or from the speech codec registers at the rate defined by PCMCLK. PCMCDI is an output data line from MCU to codec and PCMCDO is an input data line from codec to MCU. The data and control flows on separate serial busses.

– CTRLU – RF

MCU has internal 8 channel 10 bit AD converter. Following signals are used to monitor RF: TRF RF temperature (currently not in use)

– CTRLU – ACCESSORIES

M2BUS is used to control external accessories. This interface can also be used for factory testing and maintenance purposes.

– MINIMUM – MODE

This special mode can be reached through a M2BUS command or by connecting the pin MMODE of the Data Connector to the M2BUS while the phone is powered up.

PWRU

The protection against overvoltage or wrong polarity on the supply lines is included in this block which further creates the supply voltages for the baseband block, for the RF synthesizer and switches the supply to the handset and audio power amplifier.

Main Components

– Pre regulator

Stabilizes the input supply voltage to 6.5 V for the PSL+and supplies regulated power for RF module.

– PSL+ and ASIC

Generates voltages for baseband and reset signal for the ASIC. Contains power on switch, supply voltage detector and watchdog.

– Supply voltage monitor

Supervises the supply voltage within the specified Window.

– Power switch

Switches on the supply voltage for the pre–regulator handset and audio power amplifier.

Input Signals of PWRU

Name(from):	Description:
XPWRON(handset)	Power on/off button of handset (or IGNS sense ON signal)
XPWROFF(CTRLU)	Power off control, watchdog pulses from MCU
VBATT(sys.conn)	Car battery voltage
8V5_RX_X(RF)	Regulated voltage from RF module
IGNS(sys.conn.)	Ignition sense from car ignition key

Output Signals of PWRU

Name(from):	Description:
XRES(ASIC)	Master reset
VL1(CTRLU, ASIC,RFI)	Logic supply voltage
VL2(DSPU)	Logic supply voltage
VA1(AUDIO,UIF)	Analog supply voltage
VA2(RFI)	Analog supply voltage
VREF(CTRLU,RF)	Reference voltage 4.65 V ±2 %
VBATT_RF (RF; TX+RX)	Supply for RF regulators
VBSW_I(data conn)	VBATT switched for LF amplifier and for the handset
6V5_RF	Regulated supply of the baseband that supplies power to(RF synth,TX) a part of the RF module too
VBATT_I(RF PA)	Battery voltage to RF PA, fused and protected against overvoltage
VBDET(ASIC)	Indicates VBATT is within window allowing transmission
IGNDET(ASIC)	Indicates logic level of ignition sense input line
PAOFF(RF PA)	Disables RF PA when supply voltage is outside the allowed window
ANTC(sys.conn)	Antenna control, current limited output that follows VBATT

Block Description

The PSL+ IC produces the following regulated supply voltages:

- 2 * VL 150 mA for logic
- VA1 40 mA for audios
- VA2 80 mA for RFI
- VREF 5 mA reference

In addition it has internal watchdog voltage detection. The watchdog will cut off output voltages if it is not reset once every 1.5 (±0.75) second. The voltage detector resets the phone if the supply voltage falls below 6.4 V .

The IGNS input signal from the System Connector is low pass filtered to remove very short pulses and is then fed to a differentiation circuit which will turn the power on by pulling XPWRON low. The filtered IGNS is also fed to the ASIC allowing the MCU SW to monitor the actual logic state of this pin. The IGNS turn on pulse is in the order of 200 msec.

When the phone is off no part of the circuit is powered up. The phone can only be powered up by pushing the on/off button or pulling the IGNS line high.

When the on/off button is pushed the power FET turns the pre–regulator and PSL+on. The PSL+ keeps the pre–regulator on. The IGNS circuit provides the same effect as pushing the on/off button.

The phone is turned off by pushing the on/off button. The handset transmit an off message to the MCU which will stop emitting watchdog pulses for the PSL+. The PSL+ times out and the phone turns off.

DSPU

Main interfaces of the DSP:

- MCU via ASIC mailbox
- ASIC
- audio codec
- data bus interface (DBUS) for accessories
- digital audio interface (DAI) for type approval measurements

Main features of the DSP block:

- speech processing
    - speech coding/decoding
        - RPE–LTP–LPC (Regular pulse excitation long term prediction linear predictive coding)
    - voice activity detection (VAD) for discontinuous transmission (DTX)
    - comfort noise generation during silence
    - acoustic echo cancellation
- channel coding and transmission
    - block coding (with ASIC)
    - convolutional coding
    - interleaving
    - ciphering (with ASIC)
    - burst building and writing it to ASIC

- Reception
  - reading the A/D conversion results from ASIC
  - impulse response calculation
  - matched filtering
  - bit detection (with Viterbi on ASIC)
  - de–interleaving of soft decisions
  - convolutional decoding (with Viterbi)
  - block decoding (with ASIC)
- Adjacent cell monitoring
  - signal strength measurements
  - neighbor timing measurements
  - neighbor parameter reception
- control functions
  - RF controls
    - synthesizer control
    - power ramp programming
    - automatic gain control (AGC)
    - automatic frequency control (AFC)
  - frame structure control
    - controlling the operations during a TDMA frame (with ASIC)
    - controlling the multi–frame structure
    - channel configuration control
- test functions
  - functions for RF measurements
  - debugging functions for product development

Main Components of DSPU

- AT&T DSP 1616–X11

  Digital signal processor with 12 kword internal ROM
- Two 32k *8 70 ns SRAMs for DSP external memory
- 60.2 MHz crystal oscillator to generate differential small signal clock for the DSP

Input Signals of DSPU

Name(from):	Description:
VL1(PWRU)	Logic supply voltage for DSP clock and buffer
VL2(PWRU)	Logic supply voltage
DSPCLKEN(ASIC)	Clock enable for DSP clock oscillator circuit
DSP1RSTX(ASIC)	Reset for the DSP
PCMDATRCLKX (ASIC)	PCM data input clock, DBUS data output clock
CODEC_CLK	PCM data output clock
PCMOUT(AUDIO)	Received audio in PCM format
DBUSCLK	DBUS data output clock
DBUSSYNC	DBUS data bit sync clock
RDA(data conn.)	DBUS received data
INT0, INT1(ASIC)	Interrupts for the DSP
PCMCOSYCLKX (ASIC)	PCM data bit sync clock

Output Signals of DSPU

Name(to):	Description:
PCMIN(AUDIO)	Transmitted audio in PCM format
IOX(ASIC)	I/O enable, indicates access to DSP address space
RWX(ASIC)	Read/write X
DSPAD(16;9)(ASIC)	Address bus and control signals
DBUSDET(ASIC)	RDA line for DBUS activity detection by ASIC
TDA(data conn.)	DBUS transmitted data

Bidirectional Signals of DSPU

Name(from/to):	Description:
DSPDA(15;0)(ASIC)	16 bit data bus

Block Description of DSPU

The Control unit communicates with the DSP circuitry through a mailbox in the ESA ASIC. The part of the DSP SW that resides in external SRAM is loaded from Flash Prom is software is loaded through this mailbox at start up.

The DSP includes two serial busses. One is used for speech data transfer between the DSP and the codec. The other is used as an external data bus and it is connected to the Data Connector. This bus can be used by data accessories and also as a digital audio interface (DAI) in audio type approval measurements. The clocks (512 kHz main clock and 8 kHz sync. clock) are generated by the ASIC.

In transmit mode the DSP codes the speech and routes the resulting transmit slots to the ESA. The ESA ASIC controls timing, and at specified intervals sends these bits to the RFI for DA conversion.

In digital receive mode the RFI AD converts the IF signal from the RF unit under the control of the ESA. The DSP controls the ESA and receives the converted bits. After channel and speech decoding, bits are converted into an analog signal in the PCM codec, routed and fed to the earpiece/ loudspeaker.

The DSP controls the RF module through the ESA ASIC, where all necessary timing functions are implemented, and control I/O lines are provided eg. for synthesizer loading.

The DSP emulator can be connected to DSP pins TCK, TMS, TDO, TDI, GND and VDD.

The DSP clock buffer can be turned off via a control pin on the ASIC to save current when the DSP clock is not needed.

AUDIO

The AUDIO block consists of an audio codec , conditioning amplifiers for the audio inputs and outputs and a power amplifier for the external loudspeaker.
The codec contains microphone and earpiece amplifiers and all the necessary switches for signal routing. The codec is controlled by the MCU. The PCM data comes from and goes to the DSP.

The power amplifier drives the external loudspeaker for handsfree function, and a highpass filter removes unwanted low frequency noise picked up by the handsfree microphone.

Main Components of AUDIO

– Class B amplifier built using an op amp and discrete power transistors.

– Audio codec ST5080

– Contains: PCM codec, audio routing switches, microphone and earpiece amplifiers for 2 connections (internal and external devices) and DTMF generator.

High pass filter/amplifier for the handsfree microphone.

Power amplifier for the external handsfree loudspeaker.

Input Signals of AUDIO

Name(from):	Description:
VA1(PWRU)	Analog supply voltage
VBSW_1(PWRU)	Switched VBATT supply for the pre–regulator power amplifier (and handset)
PCMIN(DSPU)	Received audio in PCM format
SYNC(ASIC)	8 kHz frame sync
CODEC_CLK(ASIC)	512 kHz codec main clock
PCMCDI(CTRLU)	Audio codec control data
PCMCLK(CTRLU)	Clock for audio codec control data transfer
XSELPCMC (CTRLU)	Audio codec chip select
HFMIC(syst.conn.)	External microphone
NOK_OEM(ASIC)	Control line to set the mic sensitivity according to VDA recommendations
MIC(syst.conn)	Handset microphone

Output Signals of AUDIO

Name(to):	Description:
PCMOUT(DSPU)	Transmitted audio in PCM format
PCMCDO(CTRLU)	Audio codec control data
EAR(syst.conn.)	Audio to handset
LSP(syst.conn)	Audio to handsfree loudspeaker

Block Description of AUDIO

The handset microphone is connected to the codec through an attenuator. The external handsfree microphone is DC–biased by approx. 8V. The handsfree mic signal is amplified and filtered and fed to the codec.

The gain of the ext. microphone input can be selected to one of two settings, one adjusted for the standard Nokia microphone and a less sensitive one adjusted for the VDA recommended sensitivity.

The microphone signal is A/D converted in thee PCM codec (A–law) and delivered to the DSP.

Digital downlink signal from the DSP is fed to the D/A converter of the codec. After the conversion the signal is low pass filtered and fed to a attenuator operating as volume control and routing switches to direct it to the earpiece of the handset or the power amplifier for the loudspeaker.

There are 8 separate volume settings. They cover a range of 15 dB for the earpiece and a range of 31 dB for the handsfree speaker.

The audio codec communicates with the DSP (analog speech) through an SIO (signals: PCMIN, SYNC, CODEC_CLK and PCMOUT) . The MCU controls the audio codec function through a separate serial bus (signals: PCMCDO, PCMCDI, PCMCLK and XSELPCMC). Gainsetting, routing , tone generation etc in the codec is controlled through writing to registers in the codec. The 512 kHz clock and 8 kHz sync signal are produced by the ASIC clock signals.

The codec generates DTMF tones (key beeps), ringing and warning tones etc. for the external speaker. Some tones come also from the network.

ASIC

The ASIC takes care of the following functions :

– interface between MCU, DSP and RFI
– hardware accelerator functions to DSP SW
– clock generation, clock distribution and clock disable/enable
– RF controls
– Timers
– M2BUS and D–BUS detect and D–BUS clock and sync generation
– SIM interface
– Control inputs and outputs for the system connector.

Main Components of ASIC

– ESA ASIC
– RFC buffer, a package of logic level inverters

Input Signals of ASIC

Name(from):	Description:
VL1(PWRU)	Logic supply voltage
VL2(PWRU)	Logic supply for SIM reader
IOX(DSPU)	I/O enable, indicates access to DSP address space
RWX(DSPU)	Read/write X
WSTROBEX (CTRLU)	MCU's write strobe
RSTROBEX (CTRLU)	MCU's read strobe
RFC(RF)	Reference clock from VCTCXO
XRES(PWRU)	Master reset
DSPAD(16;0)(DSPU)	Address bus and control signals
MCUAD(19;16,4;0) (CTRLU)	MCU's address bus
DAX(RFI)	Data acknowledge
MBUSDET(CTRLU)	MBUS activity detection
DBUSDET(DSPU)	DBUS activity detection
IGNDET(PWRU)	Logic level of IGNS
VBDET(PWRU)	Indicating VBATT is within window to allow transmission
SIM_DETECT (SIM reader)	Logic signal indicating that a SIM card is present
PAOFF(PWRU)	Indicating that operation of the RF PA stage is disabled

Output Signals of ASIC

Name(to):	Description:
INT0,INT1(DSPU)	Interrupts for DSP
NMI(CTRLU)	Not maskable interrupt request
IRQX(CTRLU)	Interrupt request
RESETX (CTRLU,RFI)	Master (power up) reset

Name(to):	Description:
DSP1RSTX(DSPU)	Reset for the DSP
WRX(RFI)	Write strobe
RDX(RFI)	Read strobe
RFIAD(3;0)(RFI)	RFI address bus
SCLK(RF)	Synthesizer load clock
SDATA(RF)	Synthesizer load data
SENAR(RF)	Receiver synthesizer enable
SENAT(RF)	Transmit synthesizer enable
RXPWR(RF)	RX circuitry power enable
TXPWR(RF)	TX circuitry power enable
SYNTHPWR(RF)	Synthesizer circuitry power enable
TXP(RF)	Transmit enable
MCUCLK(CTRLU)	Main clock for MCU
DSPCLKEN(DSPU)	DSP clock circuit enable
RFICLK(RFI)	RFI master clock
RFI2CLK(RFI)	RFI sleep clock
CODEC_CLK (DSPU,AUDIO)	PCM data clock
PCMDATRCLKX (DSPU)	Inverted PCM data clock, used as input clock for codec and DBUS interface
SYNC(AUDIO)	Bit sync clock
PCMCOSYCLKX (DSPU)	Bit sync clock, inverted
DCLK(DSPU)	DBUS data clock
DSYNC(DSPU)	DBUS bit sync clock
SIMCLK(UIF)	SIM data clock
VSIM(UIF)	SIM power control
ROMSELX(CTRLU)	Chip select for the FLASH memory
ROMAD18 (CTRLU)	Chip select for the FLASH memory (FLASH1)

Name(to):	Description:
EROMSELX (CTRLU)	Chip select for the EEPROM memory
RAMSELX(CTRLU)	Chip select for the SRAM memory
CRM(sys.conn)	Car radio mute
NOKIA_OEM (AUDIO)	Set ext. mic. sensitivity to VDA recommended value
PA_ADJ	Power adjustment for RF PA.
EAL(sys.conn)	External alert

Bidirectional Signals of ASIC

Name(from/to):	Description:
DSPDA(15;0) (DSPU)	16 bit data bus
MCUDA(7;0) (CTRLU)	MCU's 8 bit data bus
RFIDA(11;0)(RFI)	12 bit data bus
SIMDATA(UIF)	Serial data to SIM

Block Description of ASIC

PSL+ supplies the reset to the ASIC at power up. The ASIC starts the clocks to the DSP and the MCU. After about 20 µS the ASIC releases the resets to all circuitry. MCU and RFI reset is released after 256 13 MHz clock cycles. DSP reset release time from DSP clock activation can be selected from 0 to 255 13 MHz clock cycles. In our case 255 is selected. SIM reset release time is according to GSM SIM specifications.

Two inverters buffers the 26MHz clock from the VCTCXO to the ASIC to minimize the effect on the clock signal caused by varying load on the clock. In the ASIC the clock is further buffered, divided and gated for the MCU, RFI, SIM. The ASIC. It also generates main and sync clocks for audio codec, DSP's SIOs and DBUS. The clock outputs can be disabled in order to save current when the clock is not needed. The DSP oscillator buffer can be turned off by the ASIC.

Interface to the MCU consists of 8 bit data bus ,5 bit lower address bus, 4 bit upper address bus, RSTRBEX, WSTROBEX, IRQX and NMI. ASIC is in the same memory space as MCU memories (memory mapped on the MCU). The ASIC generates chip select's from the address bits A16–19. There is also M2BUS detector, netfree counter and D–BUS detector in the ASIC. Netfree interrupt IRQX occurs if no activity is detected in M2BUS in about 3 ms. NMI is used to wake up the MCU from sleep mode.

MCU and DSP communicate through ASIC. ASIC has an MCU mailbox and a DSP mailbox. MCU writes data to DSP mailbox where DSP can only read the incoming data. In MCU mailbox the data transfer direction is the opposite. The size of the mailbox is 64 * 8 bit.

The SIM interface is the electrical interface between the smart card used in the GSM and the MCU via the ASIC. ASIC converts the serial data received from the SIM to parallel data for MCU and converts parallel data from MCU to serial mode for the card. The SIM interface also takes care of the power up and down procedure to the card, frame and parity error checking. The communication between card and ASIC is asynchronous and half duplex. Four signals are used between the ASIC and the SIM card: SIMDATA, SIMCLK,SIMRESET and VSIM. The clock frequency is 3.25 MHz. When there is no data transfer between the SIM card and the Mobile the clock can be reduced to 1.625 MHz. Some SIM cards also allows the clock to be stopped in that mode. Supply voltage VSIM can be switched off by the ASIC. The supply voltage is 4.65 V. The carddetect input on the ASIC is connected to the carddetect switch of the SIM reader and when the pin goes low (card not present) the ASIC will drive the SIM Interface down in a controlled and well specified manner. The carddetect switch is activated by the SIM–card and wil open/close while the contacts of the SIM card are engaged with the SIM reader.

The interface to the DSP consists of 6 bit address bus, 16 bit data bus, IOX and RWX lines. Data bus is latched using IOX, address bus is not. The ASIC also generates interrupt INT0 when an edge occurs in DBUS line (if the mask bit is off). INT1 is used as RX interrupt and as MFI modulator interrupt to the DSP.

The Viterbi block is used to perform GSM/PCN convolutional decoding and bit detection according to viterbi algorithm. It can be controlled and accessed thoroughly by the DSP.

Coder is used to perform block encoding, decoding, and ciphering according to GSM algorithm A5 (only A5 not A5–2).

The ASIC takes care of the interface between the DSP and the RFI: TX modulator, RX filter, TX and RX sample buffers and controlling state machine. The interface to RFI consists 12 bit data bus, 4 bit address bus, RDX and WRX. There is data acknowledge (DAX) from RFI to ASIC. Also in this block are the serial RF synthesizer interface (SCLK, SDAT) and the digital RF control signals (RXPWR, TXPWR, TXP, SYNTHPWR)

RFI

The RFI block consists of the RFI ASIC and its reference voltage generator. This block is an interface between the RF and baseband sections. The RFI block has the following functions:

- Receive and A/D convert the II and Q signals delivered by the IF amplifier of the RF module
- Produce I and Q TX modulation signals through D/A conversion plus filtering
- Prepare the Automatic Frequency Control signal via D/A conversion
- Prepare TX power ramp TXC via D/A conversion
- Hold AGC setting data in a register

Main Components of RFI

- RFI ASIC
- 4.096 V external voltage reference LM4040 for RFI

Input Signals of RFI

Name(from):	Description:
VL1(PWRU)	Logic supply voltage
VA2(PWRU)	Analog supply voltage
RESETX(PWRU)	Master (power up) reset
RFIAD(3;0)(ASIC)	RFI address bus
RDX(ASIC)	Read strobe
WRX(ASIC)	Write strobe
RFICLK(ASIC)	RFI master clock
RFI2CLK(ASIC)	RFI sleep clock
RXQ(RF)	RX quadrature signal
RXI(RF)	RX in phase signal

Output Signals of RFI

Name(to):	Description:
DAX(ASIC)	Data acknowledge
AFC(RF)	Automatic frequency control voltage
TXC(RF)	TX transmit power control voltage
TXQP,TXQN(RF)	Differential TX quadrature signal
TXIP,TXIN(RF)	Differential TX in phase signal
PDATA(5;0)(RF)	Parallel AGC data for controlling the RF AGC amplifiers
VREF_2(PWRU)	Reference used by VBATT window comparator

Bidirectional Signals of RFI

Name(to):	Description:
RFIDA(11;0)(ASIC)	12 bit data bus

Block Description of RFI

The RFI provides A/D conversion of the in–phase (RXI) and quadrature (RXQ) signals in the receive path. It has got 12 bit sigma–delta A/D converters and the sample rate is 541.667 kHz.

Analog transmit path includes 8 bit D/A converters to generate the in–phase (TXI) and quadrature (TXQ) signals. RFI has differential outputs for TXI and TXQ. The sample rate is 1.0833 MHz.

There is a 11 bit D/A converter for automatic frequency correction. The sample rate is 1.3542 kHz.

Power ramp is done with 10 bit D/A converter. The sample frequency is 1.0833 MHz.

Digital AGC control is done with PDATA outputs.

The RFI has 12 bit data bus to the ASIC. The registers in the RFI are accessed using 4 address bits. Control and clock signals are produced by the ASIC.

The RFI has external 4.096 V voltage reference.

RF Block Description

The RF block carries out all the RF functions of the transceiver. The RF block works in GSM system.

Regulators

There are three regulators in the RF unit. The 1'st regulator is used for the synthesizers. The 2'nd regulator is used for the receiver and the transmitter discrete circuits. The 3'rd regulator (8.3V) is used for the TX ramping circuit and RX amplifiers. The regulators reduce the car supply voltage to the fixed 5.0 V and 8.3 V. The receiver, synthesizer and transmitter circuits can be switched ON and OFF separately. Switching sequence timing depends on the operation mode of the phone.

Power Distribution

All currents in the power distribution diagram (see RF Power Distribution Diagram) are values with the sub modules in "on" condition. Activity percentages in SPEECH mode are 22.5 % for RXPWR, 15.8 % for TXPWR and 100 % for SYNTHPWR. In IDLE mode, activities are 0.36 %, 0.0 % and 1.61 %, respectively. Switching of the supply voltage for each block is controlled independently, and for example TXPWR and RXPWR are not on, at the same time.

Current Consumption

In the following table the RF current consumption can be seen with different status of the control signals. The VCTCXO is not included in the results.

SYNTHPWR:	RXPWR:	TXPWR:	TXP:	Typ. load current:	Notes:
L	L	L	L	0.1 mA	Leakage current
H	L	L	L	45 mA	Synthesizers and VCTCXO active
H	H	L	L	60 mA	Receive mode
H	L	H	H	4500 mA	Transmission

Receiver

The received RF signal from the antenna is fed via a duplex filter to the receiver unit. The duplex filters receiver branch is a bandpass filter. The signal is amplified by a discrete low noise preamplifier. The gain of the amplifier is controlled by the AGC control line (PDATA0). The nominal gain of 15 dB is reduced in strong field conditions by about 30 dB. After the preamplifier the signal is filtered by a dielectric filter. The filter and the duplex filter rejects outband spurious signals coming from the antenna and spurious emissions coming from inside the receiver unit. After the filter a second LNA is placed in order to have enough gain before the mixer.

The received signal is down converted by a passive double balanced mixer. The first IF is 71 MHz.

The IF–signal is filtered using a SAW filter. This filter reject adjacent channels signal, intermodulation signals and the second mirror. The AGC dynamic range is split up in two amplifiers. First AGC–amplifier with maximum 45 dB, and second AGC–amplifier with maximum 12 dB gain. Last mentioned amplifier is integrated in the receiver IC. The 57 dB gain is regulated in 3 dB step, using AGC control line PDATA 1–4. The second IF center frequency is 13 MHz. The second IF mixer is integrated in the receiver IC. The 13 MHz filter is a cheap ceramic filter. Also this filter has adjacent channel and intermodulations rejection. Before the 13 MHz IF signal is A/D–converted, the signal is amplified and split up in two quadrature signals, using high and low pass filters.

Duplex Filter

The duplex filter consists of two filters, RX and TX filter branch. The TX filter is a notch–filter and it rejects the noise power at the RX frequency band and TX harmonic signals. The RX filter (bandpass) rejects outband blocking and spurious signals coming from the antenna.

Parameter	*Value TX*	*Value RX*
Center frequency:	*902.5 Mhz*	*947.5 MHz*
Pass band width (BW):	*±12.5 MHz*	*±12.5 MHz*
Insertion loss at BW:	*1.5 dB max.*	*2.6 dB max.*
Ripple at BW:	*1.2 dB max.*	*1.5 dB max.*
Terminating impedance:	*50 Ω*	*50 Ω*
V.S.W.R. at BW:	*1.8 max.*	*1.8 max.*
TX attenuation:		
• 935...960 MHz	*30 dB min.*	
• 1780...1830 MHz	*30 dB min.*	
• 2670...2745 MHz	*30 dB min.*	

Parameter	*Value TX*	*Value RX*
RX attenuation:		
• D.C...915 MHz		*35 dB min.*
• 980...1031 MHz		*23 dB min.*
• 1870...1920 MHz		*30 dB min.*
• 2805...2880 MHz		*15 dB min.*
Permissible input power:	*8.0 W (avg)*	

Pre–Amplifier

The pre–amplifier amplifies the received signal coming from the antenna.

Parameter	*Value*
Frequency band:	*935...960 Mhz*
Supply voltage (min/max):	*7.65...9.35 V*
Current consumption (max):	*10 mA*
Insertion gain (min/typ):	*14.5...15 dB*
Gain flatness:	*±0.5 dB*
Noise figure (max):	*2.0 dB*
Reverse isolation (min):	*15 dB*
Gain reduction PDATA0=1 (typ):	*35 dB*
IIP3: (min/typ):	*0 dBm*
Input VSWR; Zo=50 Ω (max):	*2.0*
Output VSWR; Zo=50 Ω (max):	*2.0*

RX Interstage Filters

The RX interstage filter is a dielectric filter. The filter rejects the outband spurious and blocking signals coming from the antenna.

Parameter	*Value*
Terminating impedance:	*50 Ω*
Operation temperature range:	*–25...+85° C*
Center frequency:	*947.5 MHz*
Bandwidth (BW):	*±12.5 MHz*
Insertion loss in BW (max):	*2.0 dB*
Ripple at BW:	*1.0 dB*

Parameter	*Value*
V.S.W.R. at BW:	*1.8*
Attenuation	
• D.C...890 MHz (min/max):	*30...15 dB*
• 890...915 MHz (min/max):	*12...15 dB*
• 980...1031 MHz (min/max):	*12...15 dB*
• 1077...1102 MHz (min/max):	*40...50 dB*
• 1870...1920 MHz (min/max):	*30...50 dB*
• 1941...2062 MHz (min/max):	*30...48 dB*
• 3015...3093 MHz (min/max):	*3.0...12 dB*

Second LNA

This LAN adds gain before the mixer.

Parameter	*Value*
Frequency band :	*935...960 Mhz*
Supply Voltage (min/max):	*7.65...9.35V*
Current consumption (max) :	*14mA*
Insertion gain (typ)	*8dB*
Gain Flatness:	*+/– 0.5dB*
Noise figure (max):	*2.8dB*
IIP3 (typ):	*13dBm*
Input VSWR; Zo=50 (max)	*2.0*
Output VSWR; Zo=50 (max)	*2.0*

First Mixer

The first mixer is a passive single balanced mixer. The mixer down converts the received RF signal to the 1st IF signal, 71 MHz.

Parameter	*Value*
RX frequency range (min/max):	*935...960 Mhz*
LO frequency range (min/max):	*1006...1031 Mhz*
IF range (typ):	*71 Mhz*
Input intercept point, IIP3	*+10 dBm*
LO power level (min):	*3 dBm*

Noise figure (typ):	*7 dB, SSB*
Conversion gain (typ):	*–7 dB*

First IF Amplifier

The first IF amplifier is based on discrete components. It compensates for missing amplification in the frontend.

Parameter	*Value*
Supply voltage (min/typ/max):	*8.5 V*
Current consumption (typ/max):	*20 mA*
Frequency range:	*71 Mhz*
Conversion gain (typ):	*16 dB*
Noise figure (typ):	*3 dB*
Input intercept point (typ):	*+3 dBm*
Input compression point (typ):	*0 dBm*
Parameter	*Value*
In/out matching (typ):	*50 Ω*

First IF Filter

The channel selectivity of the receiver is split up in first and second IF filters. The 71 MHz filter is a low loss SAW filter from Siemens. The filter has single–ended input and balanced output.

Parameter	*Value*
Center frequency:	*71 MHz*
Operation temperature range:	*–20...+80 °C*
Input impedance:	*3.5 kΩ//6.9 pF balanced*
Output impedance:	*3.4 kΩ//6.7 pF balanced*
Insertion loss (nom/max):	*11.5...13.5 dB*
Group delay distortion (nom/max):	*700...1300 ns*
2 dB bandwidth (min):	*±80 kHz*
3 dB bandwidth (min):	*±120 kHz*
±200 kHz (min):	*0 dB*
±400 kHz (min):	*23 dB*

±600 kHz (min):	*36 dB*
±800 kHz (min):	*40 dB*
±1600 kHz (min):	*42 dB*
Spurious rejection at fo–26 MHz:	*60 dB*

AGC Amplifier

The total dynamic AGC range for the receiver is 93 dB. The AGC amplifier from AT&T has 0...45 dB AGC gain. The gain step is adjusted in 3 dB step, using the interface lines data[1]–data[5].

Parameter	*Value*
Supply voltage (min/max):	*4.5...5.5 V*
Current consumption (max):	*16 mA*
Frequency range (min/max):	*4...100 MHz, 3 dB cutoff*
Amplifier gain (nom):	*45 dB*

Parameter	*Value*
Amplifier gain control range (min/max):	*0...45 dB*
AGC step size:	*3 dB*
Noise figure:	*10 dB*
Output intercept point (max):	*10 dB*
Absolute gain inaccuracy (max):	*±0.5 dB over temp, range*
Relative gain inaccuracy (max):	*±0.3 dB*

Receiver IF IC

The receiver integrated circuit is a semi–custom bipolar IC PMB2403 V1.4. The IC consist of the second IF mixer, 12 dB AGC amplifier and two dividers.

AGC amplifier + 2nd mixer	*Value*
Supply voltage (min/max):	*4.5...5.5 V*
Supply current (max):	*31 mA*
Input frequency range (min/max):	*45...100 MHz*
Local freq. range of mixer (min/max):	*170...400 MHz*
Conversion gain (nom):	*12 dB*

Output compression point (min):	*0.4 V_{PP}*
AGC gain step (min/max):	*0...12 dB*
Absolute gain inaccuracy (max):	*±0.5 dB over temp. range*

Dividers	*Value*
Input frequency range (min/max):	*180...400 MHz*
Divider ratio (nom):	*1/2/4*
Input power level (nom):	*–10 dBm*
Output power level (min):	*–5 dBm*

Second IF Filter

The second IF is a ceramic filter. This filter is inserted to obtain channel selectivity in the receiver.

Parameter	*Value*
Terminating impedance (nom):	*330 Ω*
Operating temp. range (min/max):	*–30...+85 °C*
Center frequency:	*13 MHz*
1 dB bandwidth (min):	*±90 kHz*
5 dB bandwidth (max):	*±220 kHz*
Insertion loss (max):	*6 dB*
Group delay distortion (max):	*1500 ns at BW*

Parameter	*Value*
Attenuation	
• fo ±400 kHz (min/nom):	*25...30 dB*
• fo ±600 kHz (min/nom):	*40...45 dB*

Second IF Amplifier

The second IF amplifier compensates for losses in the gain compensating network, and in the quadrature split.

Parameter	*Value*
Supply voltage:	*8.5 V*
Current consumption:	*10 mA*
Frequency range:	*13 MHz*

Conversion gain:	*20 dB*
Noise figure:	*3 dB*
Input intercept point:	*+3 dBm*
Input compression point:	*0 dBm*
Input impedance:	*330 Ω*
Output impedance:	*1000 Ω*

Phase Split

The phase splitter consists of two filters, a highpass and lowpass. The phase difference between the two output signals is 90 deg.

Parameter	*Value*
Frequency:	*13 Mhz*
Imbalance amplitude (max):	*1 dB*
Imbalance phase (max):	*2 deg*
Attenuation from input RXI or RXQ:	*9 dB*
Output impedance:	*470 Ω*

Transmitter

The transmitter frequency is generated by mixing the buffered UHF VCO signal by the 116 MHz (232 MHz from the VHF VCO divided by 2). Reject the noise in hte RX band from the modulator and PA Stage. The mixer is double balanced diode mixer, from the LO port , which is fed by the UHF signal. The final TX frequency is filtered before it is modulated in the modulator.

The TX signal is amplified and filtered before it feeds the integrated power amplifier with app. 8 dBm.

The interstage filters reject the unwanted mixer products, and together with the TX part of the duplex filter, reject the noise in the RX band from the modulator and the P/A.

The power amplifier delivers the transmitter output to the duplex filter, which rejects the harmonics and wideband noise in the RX band. Max outputpower at the antenna connector: 39dBM=8W

From the RF interface circuit (RFI), the power level and the up– and down ramping is controlled by the TXC signal. The amplitude of this signal, which has a raised cosine form, controls the power level from 13 dBm to 39 dBm. A directional coupler gives the feedback signal in the power control loop, to which the raised cosine is an external signal reference.

Modulator Circuit

The modulator is a quadrature modulator IC PMB 2200 from Siemens. The RF signal is first doubled and then divided (with two) to get accurate 90 degrees phase shifted signals to the I/Q mixers. After mixing, the signals are combined and amplified. The balanced output is loaded and converted to single ended of a transformer, which also add some bandpass filtering.

Parameter	*Value*
Supply voltage (min/max):	*4.5...5.5 V*
Supply current (typ/nom/max):	*32...40...48 mA, norm operation*
Transmit frequency input	***Value***
LO input frequency (min/max):	*800...970 MHz*
LO input power level (min/max):	*–20...4 dBm*
Modulator Inputs (I/Q):	***Value***
Input bias current, balanced (max):	*6.0...12 µA*
External d.c. reference (min/max):	*2.1...2.6 V*

Differential input amplit. (min/typ/max):	*0.8...1.0...1.2 V_{PP}*
Differential offset voltage (typ/max):	*1.0...3.0 mV*
Input impedance (min):	*70 kΩ*
Gain unbalance (max):	*0.2 dB*

Modulator Output:	*Value*
Available RF power (min/max):	*–9...–3 dBm, Z_{LOAD}=200 Ω*
Available saturated RF power (min/typ):	*–5...0 dBm, ZiL=50 kΩ*
Suppression of 3rd order prods (min):	*42 dB*
Single sideband suppression:	*40 dB*

Up Conversion Mixer

The mixer is a double balanced diode mixer. The local signal coming from the UHF synthesizer is balanced. The RF signal a on 116 MHz is the output from the VHF PLL divided by two in the RX IC.

Parameter	*Value*
Input frequency:	*116 MHz*
LO frequency range (min/max):	*1006...1031 MHz*
TX frequency range (min/max):	*890...915 MHz*
Conversion loss (nom/max):	*10...12 dB*
IIP3 (min):	*3.0 dBm*
LO – RF isolation (min):	*20 dB*
LO power level (max):	*6.0 dBm*

TX Interstage Filters

The TX interstage filters reject other signals than the final TX frequency from the mixer products. After the modulator they also they also reject the wideband noise from this circuit. Here only the dielectric filter is described. The other filter is realized with discrete components after the mixer.

Parameter	*Value*
Terminating impedance:	*50 Ω*
Operating temp. range (min/max):	*–25...+85 °C*
Center frequency:	*902.5 MHz*
Bandwidth BW (min):	*±12.5 MHz*

Insertion loss at BW (nom/max):	*2.3...3.0 dB*
Ripple at BW (nom/max):	*0.5...1.0 dB*
V.S.W.R. at BW (nom/max):	*1.7...2.0 dB*
Attenuation (min/typ)	
• DC...800 MHz:	*30...49 dB*
• 935...960 MHz:	*12...18 dB*
• 1006...1031 MHz:	*30...48 dB*
• 1032...3000 MHz:	*3...16 dB*

TX Amplifiers

The TX amplifier are bipolar transistor amplifiers. They amplifies the filtered TX signal coming from the down conversion mixer.

TX amplifier 1 parameters	*Value*
Operation frequency range:	*890...915 MHz*
Supply voltage:	*5.0 V*
Current consumption (nom):	*15 mA*
Gain (min):	*11.0 dB*
Noise figure (max):	*3.5 dB*
Input VSWR, Zo=50 Ω (max):	*2.0*
Output VSWR, Zo=50 Ω (max):	*2.0*

TX amplifier 2 parameters	*Value*
Operation frequency range:	*890...915 MHz*
Supply voltage:	*5.0 V*
Current consumption (nom):	*17 mA*
Gain (min):	*11.0 dB*
Noise figure (max):	*3.5 dB*
Input VSWR, Zo=50 Ω (max):	*2.0*
Output VSWR, Zo=50 Ω (max):	*2.0*

Power Amplifier

The power amplifier is a 3 stage MOS FET integrated module. The device amplifies the TX signal to the desired output level. Nominal operation voltage is 12.5 volt.

Parameters	*Value*

D.C. supply voltage max:	*17 V*
Current consumption:	*6.0 A*
Operating frequency range:	*890...915 MHz*
Operating case temp. range:	*–30...+110 °C*
Output power (min):	*42.3 dBm, normal cond.*
Output power (min):	*39.5 dBm, extreme cond.*
Input power (min/max):	*3...13 dBm*
Efficiency P_O=33.5 dBm (min/nom):	*30...35 %*
Input VSWR Z_O=50 Ω (nom/max):	*2...3*
Harmonics (nom/max)	
• 2 $F_{O:}$	*–50...–40 dBc, P_O=41.1 dBm*
• 3,4,5 $F_{O:}$	*–55...–45 dBc, P_O=41.1 dBm*

Power Control Circuitry

The power control circuit consists of a power detector, a differential control circuit and a level convert circuit, of which the latter is the interface between the TXC signal from the RFI and the power amplifier control signal. The differential control circuit compares the voltage from the power detector with the TXC signal which has a raised cosinus form.

The TX power is controlled in two ’modes’. From the off condition, with an output below –36 dBm , to an output of app. 0 dBm the power amplifier is controlled in an open loop mode. Between app. 0 dBm to the final level, the up– and down ramping is controlled in a closed loop mode.

Parameters	*Value*
Positive supply voltage:	*8.3 V*
Power control range close loop:	*40 dB*
Dynamic range of PA from V cont. (min):	*80 dB*
Input control voltage range (min/max):	*0.3...4.2 V*
Output control voltage range (min/max):	*0.5...7 V*

Frequency Synthesizers

The stable frequency source for the synthesizers and baseband circuits is the voltage controlled temperature compensated crystal oscillator, VCTCXO. The frequency of the VCTCXO is 26 MHz. The frequency of the oscillator is controlled by an AFC voltage, which is generated by the baseband circuits.

The operating frequency range of the UHF synthesizer is from 1006 to 1031 MHz. The UHF VCO is implemented as a module. The UHF synthesizer generates the down conversion signal for the receiver and the up conversion signal for the transmitter.

The operating frequency of the VHF VCO is 232 MHz. This signal is divided by two in the receiver IC and feed back to the PLL circuit. This 116 MHz signal is used in the transmitter mixer and also in the receiver IC, where the signal ones more is divided by two and used in the second mixer of the receiver.

VCTCXO

The VCTCXO is a module operating at 26 MHz. The 26 MHz signal is used as a reference frequency of the synthesizers and as the clock frequency for the base band circuits.

Parameter:	*Value*
Operating temperature range:	*–25...+75 °C*
Supply voltage (min/typ/max):	*4.6...4.7...4.9 V*
Supply current (max):	*2.0 mA*
Output frequency (nom):	*26 MHz*
Output level (min):	*1.0 $V_{PP,}$ clipped sinewave*

Parameter:	*Value*
Harmonics (max):	*–5 dBc*
Load (nom):	*10 kΩ/10 pF*
Frequency stability	
• temperature:	*±5.0 ppm, –25...+75 °C*
• supply voltage:	*±0.3 ppm, 4.7 V ±5 %*
• load:	*±0.3 ppm, load ±10 %*
• aging:	*±1.0 ppm, year*
Nominal voltage for center freq:	*2.35 V*
Frequency control (min/max):	*±8...±17 ppm, 2.35 V ±1.5 V*
Control sensitivity (max):	*±11 ppm, V*
Frequency tolerance (max):	*±15 ppm, V_C=2.35 V*
Frequency adjustment (min):	*±3.0 ppm, by internal trimmer*

VHF PLL

The VHF PLL consists of the VHF VCO, PLL integrated circuit and loop filter. The output signal, divided by to, is used for the 2nd mixer of the receiver and for the I/Q modulator of the transmitter.

Parameter:	*Value*
Start up setting time (max):	*2.0 ms*
Phase error (nom/max):	*0.3...1 deg., rms*
fo ±200 kHz (max):	*–33 dBc*
fo ±400 kHz (max):	*–63 dBc*
fo ±600 kHz (max):	*–78 dBc*
fo ±800 kHz (max):	*–78 dBc*
fo ±1.6 MHz (max):	*–84 dBc*
fo ±3.0 MHz (max):	*–84 dBc*

VHF VCO

The VHF VCO uses a bipolar transistor as a active element and a combination of a chip coil and varactor diode as a resonance circuit.

Parameter:	*Value*
Supply voltage (min/typ/max):	*4.2...4.9...5.0 V*
Control voltage (min/max):	*1.0...2.9...4.0 V*

Parameter:	*Value*
Supply current (typ/max):	*6.0...8.0 mA*
Operation frequency (typ):	*232 MHz*
Output power level (min/typ/max):	*–15...–10...–5 dBm*
Control voltage sensitivity (typ):	*9 MHz/V*
Phase noise (max)	
• fo ±200 kHz	*–75 dB*
• fo ±400 kHz	*–105 dB*
• fo ±600 kHz	*–117 dB*
• fo ±800 kHz	*–122 dB*
• fo ±1.6 MHz	*–132 dB*
• fo ±3.0 MHz	*–132 dB*
Pulling figure (max):	*±1.0 MHz, VSWR<2 any phase*

Pushing figure (max):	*±1.0 MHz/V*
Frequency stability (max):	*±1.0 MHz, over temp. range –20...+75 °C*
Harmonics (max):	*–5 dBc*
Spurious (max):	*–65 dBc*

UHF Synthesizer

The UHF Synthesizer consists of a UHF VCO module, synthesizer IC and a loop filter. The output signal is used for the 1st mixer of the receiver and the mixer of the transmitter.

Parameter:	*Value*
Start up setting time (max):	*2.0 ms*
Settling time (max):	*800 µs*
Phase error (max):	*3.0 deg., rms*
Sidebands (max)	
• ±200 kHz:	*–30 dBc*
• ±400 kHz:	*–60 dBc*
• ±600 kHz:	*–75 dBc*
• ±800 kHz:	*–77 dBc*
• 1.6 MHz:	*–87 dBc*
• >3.0 MHz:	*–87 dBc*

UHF VCO

The UHF VCO is a module which includes an output amplifier, too.

Parameter:	*Value*
Supply voltage (min/typ/max):	*4.5...4.75...5.0 V*
Control voltage (min/max):	*0.5...4.25 V*
Supply current (max):	*10.0 mA*
Operation frequency range:	*1006...1031 MHz, 0.5<Vc<4.25 V*
Output power level:	*> 6 dBm*
Control volt. sensitivity (min/typ/max):	*10...13...16 MHz/V AG*
Phase noise (max)	
• fo ±200 kHz:	*–110 dBc/Hz*
• fo ±600 kHz:	*–126 dBc/Hz*
• fo ±800 kHz:	*–131 dBc/Hz*
• fo ±1.6 MHz:	*–141 dBc/Hz*
• fo ±3.0 MHz:	*–141 dBc/Hz*

Pulling figure (max):	*±1.0 MHz, VSWR<2 any phase*
Pushing figure (max):	*±1.0 MHz/V*
Frequency stability (max):	*±2.0 MHz, over temp. range –20...+75 °C*
Harmonics (max):	*–15 dBc*
Spurious (max):	*–65 dBc*

UHF VCO Buffer

The buffer amplifies the UHF VCO signal. The VCO output signal is divided into the 1st mixer of the receiver and the down conversion mixer of the transmitter. There is one buffer for TX and one buffer for RX.

Parameter:	*Value*
Supply voltage (typ):	*4.5 V*
Supply current (typ):	*15 mA*
Frequency range:	*1006...1031 MHz*
Input power (typ):	*–2 dBm*
Output power (typ):	*+6 dBm*
Harmonics (max):	*–10 dBc*

PLL Circuit

The PLL is a high speed C–MOS IC. The circuit is used in the VHF–PLL and in the UHF synthesizer.

Parameter:	*Value*
Supply voltage (min/max):	*3.0...5.5 V*
Supply current (typ):	*3.5 mA*
Input frequency single mode (max):	*220 MHz, V_{DD}=4.5 V*
Input reference dual mode (max):	*65 MHz, V_{DD}=4.5 V*
Input reference frequency (max):	*5 MHz, V_{DD} = 4.5 V*
Clocking frequency (max):	*5 MHz*
Reference input voltage (min):	*100 mV_{RMS}*
Input signal voltage, dual mode (min):	*180 mV_{RMS}*
Input signal voltage, single mode (min):	*100 mV_{RMS}*
Phase detector output curr. (min/max):	*–6...+6 %*

Phase detector output volt. (min/max): *0.5...V_{DD}–0.5 V*

Prescaler

The dual modulus prescaler divide the the UHF VCO signal for the PLL circuit. The dividing ratios used is 64 and 65. The two different types PMB2312 and SA701D can be used.

PMB2312 parameter:	*Value*
Supply voltage (min/max):	*4.5...5.5 V*
Supply current (max):	*8 mA*
Divide rations (min/max):	*64/65...128/129 (64/65 in use)*
Toggle frequency (max):	*1100 MHz*
Output voltage swing (min):	*1.0 V_{PP}*
Input voltage sensitivity (min):	*25 mV_{RMS}=1000 MHz*

SA701D parameter:	*Value*
Supply voltage (min/max):	*2.7...6.0 V*
Supply current (max):	*4.6 mA*
Divide rations (min/max):	*64/65...128/129 (64/65 in use)*
Toggle frequency (max):	*1100 MHz*
Output voltage swing (min):	*1.6 V_{PP} (V_{CC}=5.0 V)*
Input voltage sensitivity (min):	*50 mV_{PP}=1000 MHz*

Interconnection Diagram of Baseband

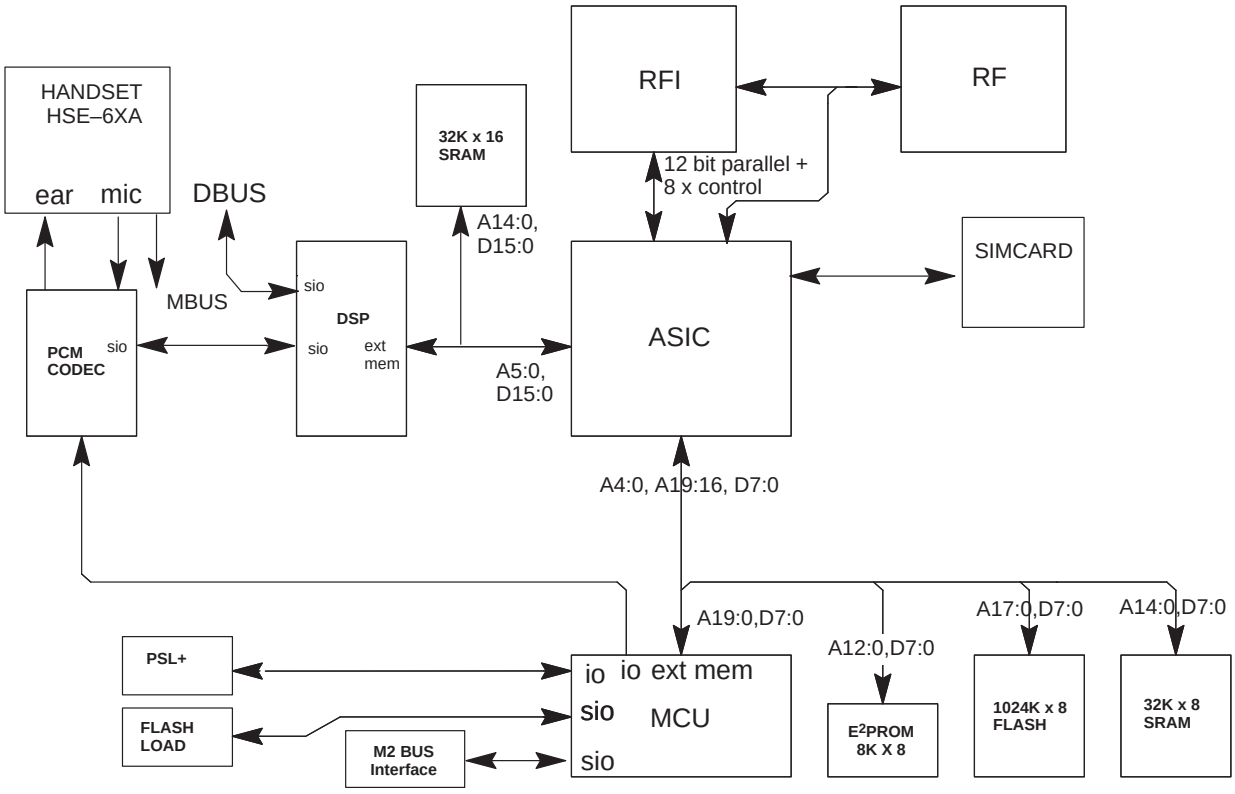

Figure 4. Interconnection Diagram – Baseband

Power Distribution Diagram of Baseband

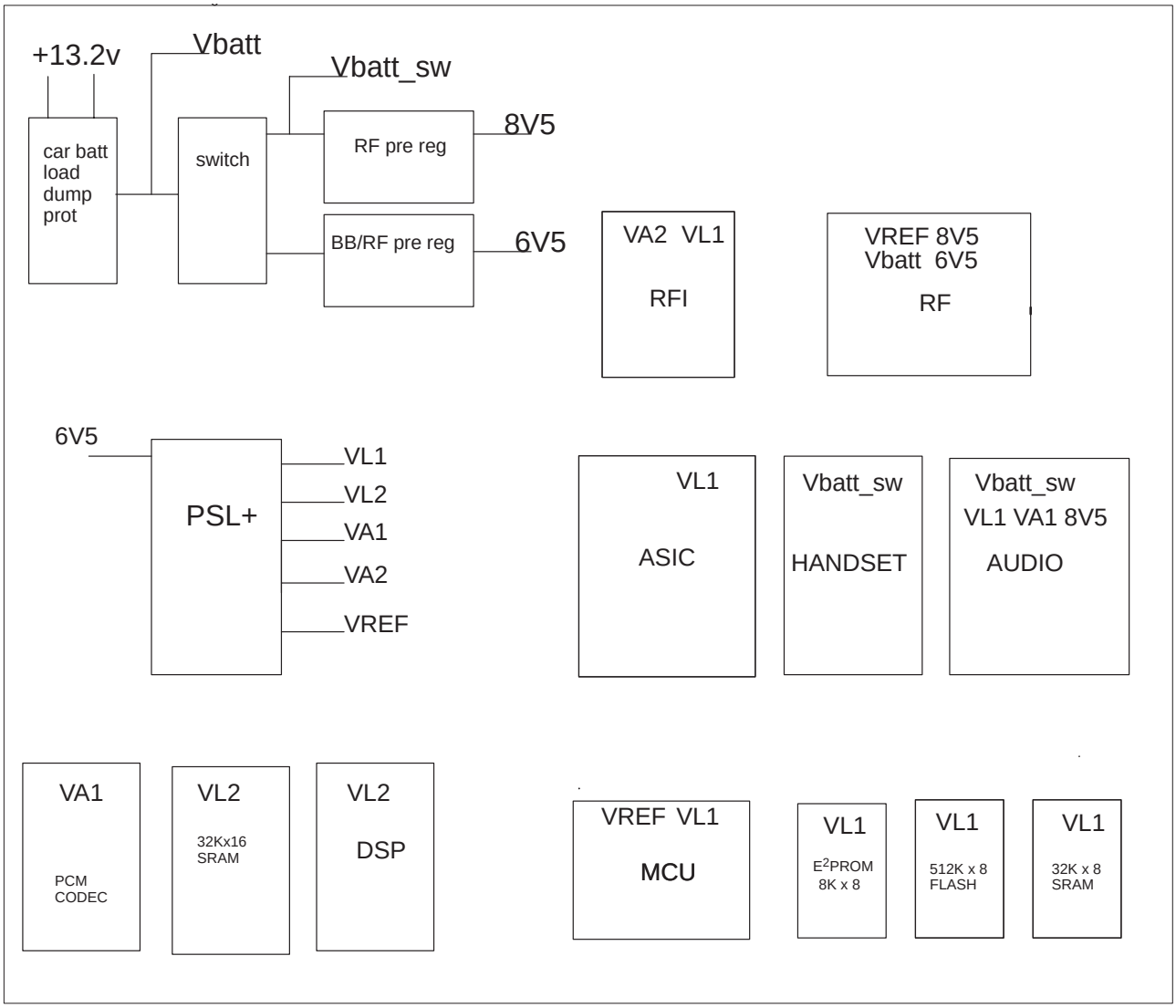

Figure 5. Power Distribution – Baseband

Block Diagram of RF

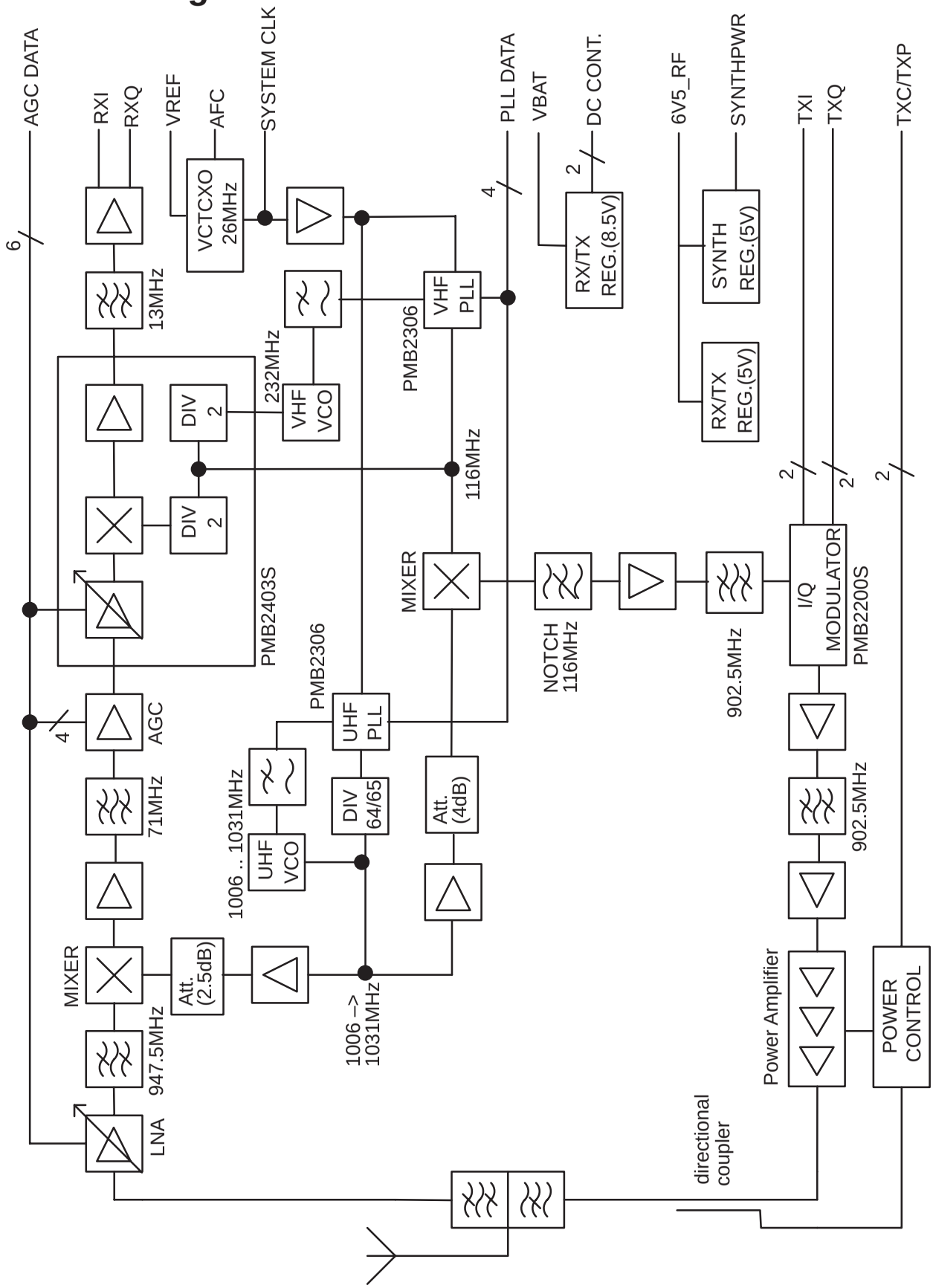

Figure 6. RF Blocdiagram.

Power Distribution Diagram of RF

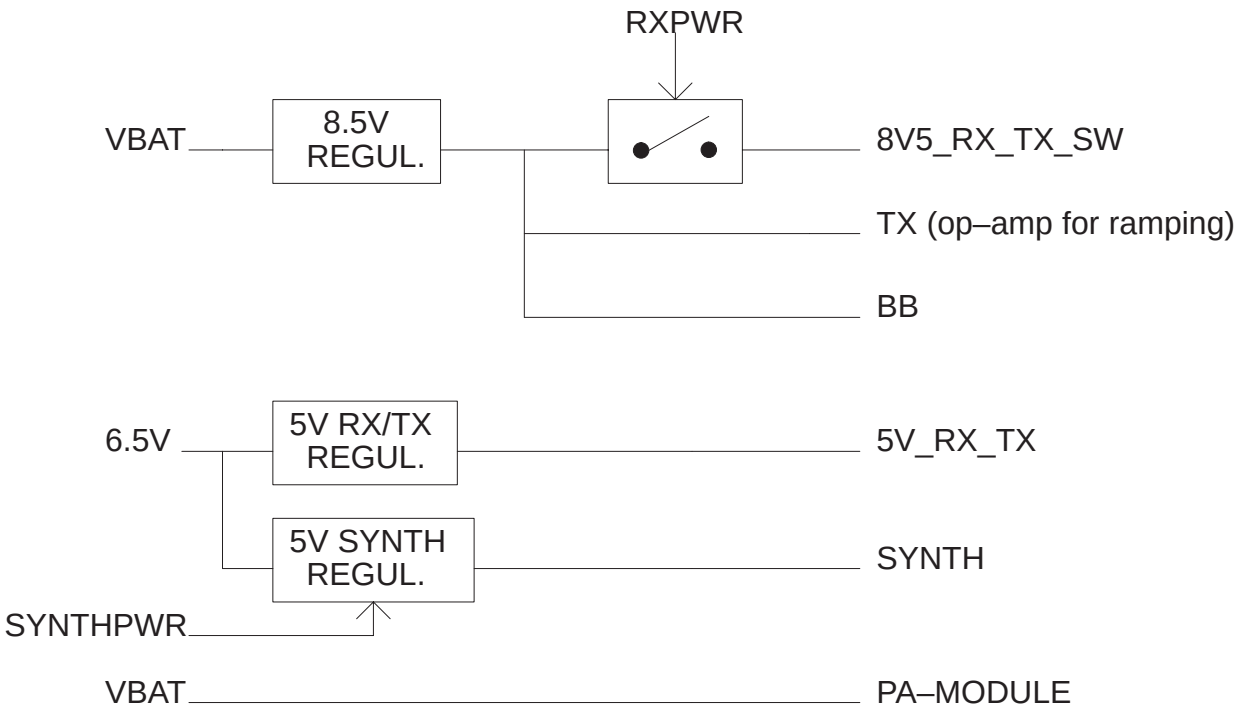

Figure 7. Power Distribution – RF

Interconnections – RF and BB

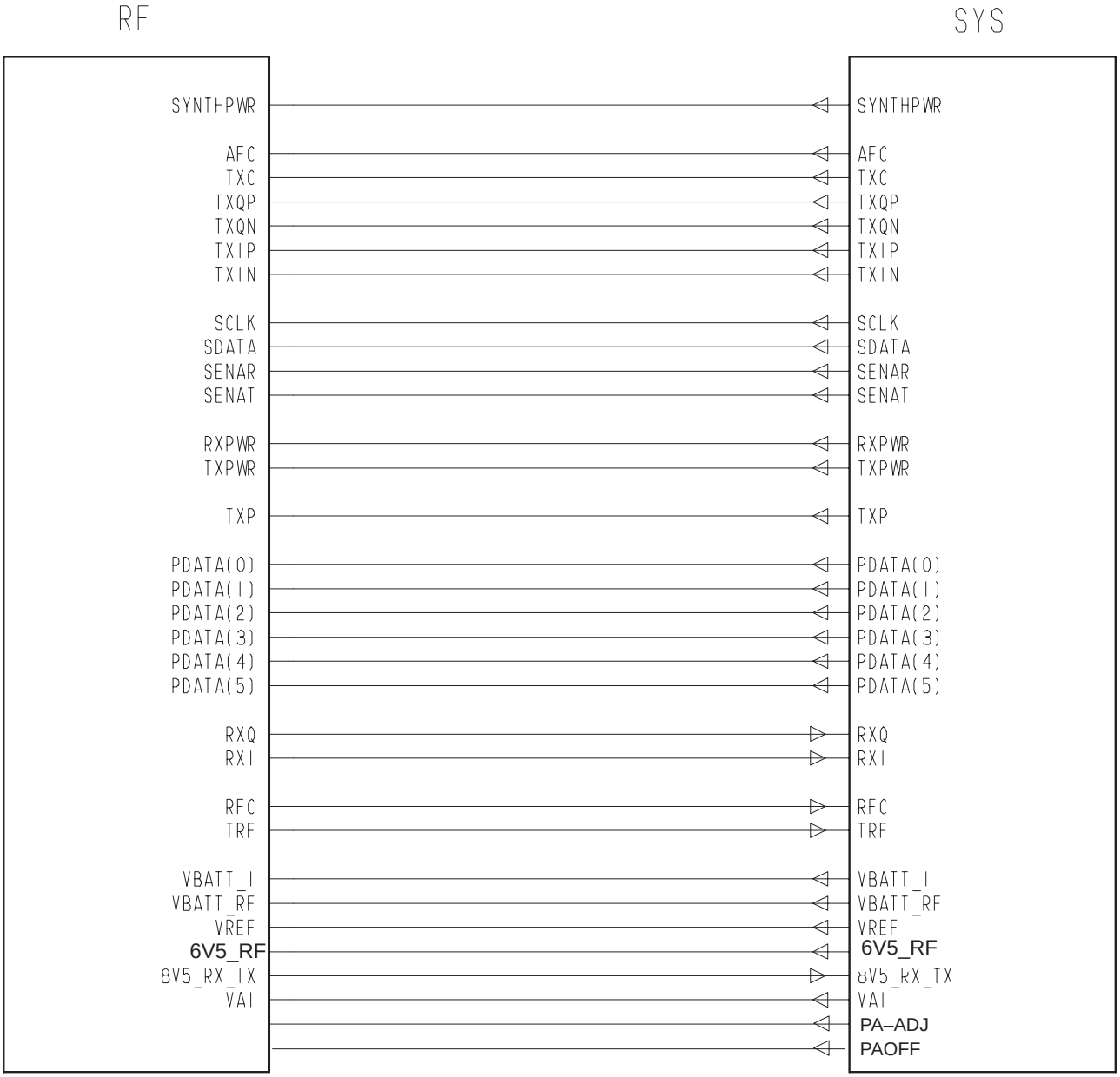

Figure 8. Interconnections – RF and BB

Block Diagram of Baseband (Version: 8.0 Edit: 127)

Circuit Diagram of MCU & EEPROM (Version: 8.0 Edit: 86)

Circuit Diagram of Power Supply

Circuit Diagram of DSPU

Circuit Diagram of Audio

Circuit Diagram of ASIC

Circuit Diagram of RFI

Block Diagram of RF

Circuit Diagram of Receiver

Circuit Diagram of Transmitter

Circuit Diagram of Synthesizers

Layout Diagram of Side 1

Layout Diagram of Side 2

Part List of GM8 (EDMS Issue: 2.6)

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R100	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R101	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R102	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R103	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R104	1430248	Chip resistor	3.9 k	2 % 0.063 W 0603
R105	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R106	1416379	Melf resistor	200 k	1 % 0.2 W 0204
R108	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R109	1430039	Chip resistor	1.5 k	5 % 0.063 W 0603
R110	1430039	Chip resistor	1.5 k	5 % 0.063 W 0603
R111	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R112	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R113	1430001	Chip resistor	100	5 % 0.063 W 0603
R114	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R115	1430151	Chip resistor	10	5 % 0.063 W 0603
R116	1430151	Chip resistor	10	5 % 0.063 W 0603
R117	1430151	Chip resistor	10	5 % 0.063 W 0603
R118	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R119	1430111	Chip resistor	1.0 M	5 % 0.063 W 0603
R120	1430111	Chip resistor	1.0 M	5 % 0.063 W 0603
R121	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R122	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R123	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R124	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R126	1421115	Melf resistor	61.9 k	1 % 0.2 W 0204
R129	1430111	Chip resistor	1.0 M	5 % 0.063 W 0603
R130	1430151	Chip resistor	10	5 % 0.063 W 0603
R131	1430009	Chip resistor	220	5 % 0.063 W 0603
R132	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R133	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R134	1430039	Chip resistor	1.5 k	5 % 0.063 W 0603
R135	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R136	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R137	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R138	1820024	NTC resistor	47 k	5 % 0.2 W 0805
R139	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R140	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R141	1430067	Chip resistor	15 k	5 % 0.063 W 0603

R142	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R143	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R144	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R145	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R146	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R147	1430001	Chip resistor	100	5 % 0.063 W 0603
R148	1430015	Chip resistor	470	5 % 0.063 W 0603
R149	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R150	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R151	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R152	1430091	Chip resistor	150 k	5 % 0.063 W 0603
R153	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R154	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R155	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R156	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R157	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R158	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R159	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R160	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R161	1430001	Chip resistor	100	5 % 0.063 W 0603
R162	1430019	Chip resistor	560	5 % 0.063 W 0603
R163	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R164	1430009	Chip resistor	220	5 % 0.063 W 0603
R165	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R166	1430091	Chip resistor	150 k	5 % 0.063 W 0603
R167	1430091	Chip resistor	150 k	5 % 0.063 W 0603
R168	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R169	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R170	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R171	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R172	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R173	1430001	Chip resistor	100	5 % 0.063 W 0603
R174	1430151	Chip resistor	10	5 % 0.063 W 0603
R175	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R176	1430095	Chip resistor	220 k	5 % 0.063 W 0603
R177	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R178	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R179	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R180	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R181	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R182	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R183	1430087	Chip resistor	100 k	5 % 0.063 W 0603

R184	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R185	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R186	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R187	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R188	1430151	Chip resistor	10	5 % 0.063 W 0603
R189	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R190	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R191	1430001	Chip resistor	100	5 % 0.063 W 0603
R192	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R193	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R194	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R195	1430151	Chip resistor	10	5 % 0.063 W 0603
R196	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R197	1430015	Chip resistor	470	5 % 0.063 W 0603
R198	1430167	Chip resistor	47	5 % 0.063 W 0603
R199	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R200	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R201	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R202	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R203	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R204	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R205	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R206	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R207	1430009	Chip resistor	220	5 % 0.063 W 0603
R208	1430077	Chip resistor	39 k	5 % 0.063 W 0603
R209	1430077	Chip resistor	39 k	5 % 0.063 W 0603
R210	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R211	1430047	Chip resistor	3.3 k	5 % 0.063 W 0603
R212	1430009	Chip resistor	220	5 % 0.063 W 0603
R213	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R214	1430001	Chip resistor	100	5 % 0.063 W 0603
R215	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R216	1430298	Chip resistor	1.0 M	2 % 0.063 W 0603
R218	1430151	Chip resistor	10	5 % 0.063 W 0603
R219	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R220	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R221	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R222	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R223	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R224	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R225	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R226	1430037	Chip resistor	1.2 k	5 % 0.063 W 0603

R242	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R244	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R245	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R248	1430151	Chip resistor	10	5 % 0.063 W 0603
R249	1430167	Chip resistor	47	5 % 0.063 W 0603
R250	1430001	Chip resistor	100	5 % 0.063 W 0603
R251	1430001	Chip resistor	100	5 % 0.063 W 0603
R252	1430001	Chip resistor	100	5 % 0.063 W 0603
R253	1430001	Chip resistor	100	5 % 0.063 W 0603
R254	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R255	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R256	1430001	Chip resistor	100	5 % 0.063 W 0603
R257	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R258	1430001	Chip resistor	100	5 % 0.063 W 0603
R259	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R260	1430001	Chip resistor	100	5 % 0.063 W 0603
R261	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R262	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R263	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R264	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R265	1430151	Chip resistor	10	5 % 0.063 W 0603
R266	1430001	Chip resistor	100	5 % 0.063 W 0603
R267	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R268	1430001	Chip resistor	100	5 % 0.063 W 0603
R269	1430001	Chip resistor	100	5 % 0.063 W 0603
R270	1430001	Chip resistor	100	5 % 0.063 W 0603
R271	1430151	Chip resistor	10	5 % 0.063 W 0603
R272	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R273	1430001	Chip resistor	100	5 % 0.063 W 0603
R274	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R275	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R276	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R277	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R278	1430001	Chip resistor	100	5 % 0.063 W 0603
R279	1430151	Chip resistor	10	5 % 0.063 W 0603
R300	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R301	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R302	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R303	1430001	Chip resistor	100	5 % 0.063 W 0603
R304	1430001	Chip resistor	100	5 % 0.063 W 0603
R305	1430151	Chip resistor	10	5 % 0.063 W 0603
R306	1430087	Chip resistor	100 k	5 % 0.063 W 0603

R307	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R308	1430001	Chip resistor	100	5 % 0.063 W 0603
R309	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R310	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R311	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R312	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R314	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R315	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R316	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R317	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R318	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R319	1430001	Chip resistor	100	5 % 0.063 W 0603
R320	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R321	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R322	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R323	1430001	Chip resistor	100	5 % 0.063 W 0603
R324	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R325	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R326	1430067	Chip resistor	15 k	5 % 0.063 W 0603
R327	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R328	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R329	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R330	1430151	Chip resistor	10	5 % 0.063 W 0603
R331	1430151	Chip resistor	10	5 % 0.063 W 0603
R333	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R334	1430151	Chip resistor	10	5 % 0.063 W 0603
R335	1430151	Chip resistor	10	5 % 0.063 W 0603
R336	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R337	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R338	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R339	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R340	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R341	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R342	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R343	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R344	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R345	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R346	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R350	1430015	Chip resistor	470	5 % 0.063 W 0603
R351	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R353	1430001	Chip resistor	100	5 % 0.063 W 0603
R354	1430039	Chip resistor	1.5 k	5 % 0.063 W 0603

R355	1430151	Chip resistor	10	5 % 0.063 W 0603
R356	1430151	Chip resistor	10	5 % 0.063 W 0603
R357	1430151	Chip resistor	10	5 % 0.063 W 0603
R358	1430151	Chip resistor	10	5 % 0.063 W 0603
R359	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R360	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R361	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R362	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R363	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R364	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R365	1430258	Chip resistor	10 k	2 % 0.063 W 0603
R366	1430272	Chip resistor	39 k	2 % 0.063 W 0603
R367	1430276	Chip resistor	47 k	2 % 0.063 W 0603
R368	1430288	Chip resistor	150 k	2 % 0.063 W 0603
R369	1430294	Chip resistor	220 k	2 % 0.063 W 0603
R370	1430258	Chip resistor	10 k	2 % 0.063 W 0603
R371	1430258	Chip resistor	10 k	2 % 0.063 W 0603
R372	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R373	1430270	Chip resistor	33 k	2 % 0.063 W 0603
R374	1430258	Chip resistor	10 k	2 % 0.063 W 0603
R375	1430280	Chip resistor	100 k	2 % 0.063 W 0603
R701	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R702	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R703	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R704	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R705	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R706	1430067	Chip resistor	15 k	5 % 0.063 W 0603
R707	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R708	1430144	Chip jumper		0603
R709	1430151	Chip resistor	10	5 % 0.063 W 0603
R710	1430013	Chip resistor	330	5 % 0.063 W 0603
R711	1430009	Chip resistor	220	5 % 0.063 W 0603
R712	1430005	Chip resistor	150	5 % 0.063 W 0603
R713	1430067	Chip resistor	15 k	5 % 0.063 W 0603
R714	1430021	Chip resistor	680	5 % 0.063 W 0603
R716	1430001	Chip resistor	100	5 % 0.063 W 0603
R717	1430142	Chip resistor	4.7	5 % 0.063 W 0603
R718	1430013	Chip resistor	330	5 % 0.063 W 0603
R720	1430151	Chip resistor	10	5 % 0.063 W 0603
R721	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R722	1430151	Chip resistor	10	5 % 0.063 W 0603
R723	1430065	Chip resistor	10 k	5 % 0.063 W 0603

R724	1430009	Chip resistor	220	5 % 0.063 W 0603
R725	1430013	Chip resistor	330	5 % 0.063 W 0603
R726	1430163	Chip resistor	33	5 % 0.063 W 0603
R727	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R728	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R729	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R730	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R731	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R732	1430151	Chip resistor	10	5 % 0.063 W 0603
R733	1430009	Chip resistor	220	5 % 0.063 W 0603
R734	1430015	Chip resistor	470	5 % 0.063 W 0603
R736	1430039	Chip resistor	1.5 k	5 % 0.063 W 0603
R738	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R740	1430011	Chip resistor	270	5 % 0.063 W 0603
R741	1430200	Chip resistor	120	2 % 0.063 W 0603
R742	1430200	Chip resistor	120	2 % 0.063 W 0603
R743	1430021	Chip resistor	680	5 % 0.063 W 0603
R744	1430021	Chip resistor	680	5 % 0.063 W 0603
R745	1430009	Chip resistor	220	5 % 0.063 W 0603
R746	1430009	Chip resistor	220	5 % 0.063 W 0603
R747	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R749	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R750	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R751	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R752	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R753	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R754	1430001	Chip resistor	100	5 % 0.063 W 0603
R756	1430013	Chip resistor	330	5 % 0.063 W 0603
R757	1430155	Chip resistor	15	5 % 0.063 W 0603
R758	1430013	Chip resistor	330	5 % 0.063 W 0603
R759	1430142	Chip resistor	4.7	5 % 0.063 W 0603
R760	1430077	Chip resistor	39 k	5 % 0.063 W 0603
R762	1430007	Chip resistor	180	5 % 0.063 W 0603
R763	1430013	Chip resistor	330	5 % 0.063 W 0603
R764	1430009	Chip resistor	220	5 % 0.063 W 0603
R765	1430155	Chip resistor	15	5 % 0.063 W 0603
R766	1430009	Chip resistor	220	5 % 0.063 W 0603
R770	1430142	Chip resistor	4.7	5 % 0.063 W 0603
R771	1430142	Chip resistor	4.7	5 % 0.063 W 0603
R801	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R802	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R803	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603

R804	1430001	Chip resistor	100	5 % 0.063 W 0603
R805	1430037	Chip resistor	1.2 k	5 % 0.063 W 0603
R806	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R807	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R808	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R809	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R810	1430015	Chip resistor	470	5 % 0.063 W 0603
R811	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R812	1430159	Chip resistor	22	5 % 0.063 W 0603
R813	1430047	Chip resistor	3.3 k	5 % 0.063 W 0603
R814	1430057	Chip resistor	8.2 k	5 % 0.063 W 0603
R815	1430009	Chip resistor	220	5 % 0.063 W 0603
R816	1430063	Chip resistor	12 k	5 % 0.063 W 0603
R817	1430079	Chip resistor	47 k	5 % 0.063 W 0603
R818	1430011	Chip resistor	270	5 % 0.063 W 0603
R819	1430083	Chip resistor	68 k	5 % 0.063 W 0603
R820	1430005	Chip resistor	150	5 % 0.063 W 0603
R821	1430057	Chip resistor	8.2 k	5 % 0.063 W 0603
R822	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R823	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R824	1430210	Chip resistor	7.5 k	2 % 0.063 W 0603
R825	1430210	Chip resistor	7.5 k	2 % 0.063 W 0603
R826	1430210	Chip resistor	7.5 k	2 % 0.063 W 0603
R827	1430210	Chip resistor	7.5 k	2 % 0.063 W 0603
R828	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R829	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R830	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R831	1430142	Chip resistor	4.7	5 % 0.063 W 0603
R832	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R833	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R834	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R835	1430071	Chip resistor	22 k	5 % 0.063 W 0603
R836	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R837	1430053	Chip resistor	5.6 k	5 % 0.063 W 0603
R838	1430151	Chip resistor	10	5 % 0.063 W 0603
R839	1430001	Chip resistor	100	5 % 0.063 W 0603
R840	1430171	Chip resistor	68	5 % 0.063 W 0603
R841	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R842	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R843	1430169	Chip resistor	56	5 % 0.063 W 0603
R844	1430151	Chip resistor	10	5 % 0.063 W 0603
R845	1430023	Chip resistor	820	5 % 0.063 W 0603

R846	1430001	Chip resistor	100	5 % 0.063 W 0603
R847	1430067	Chip resistor	15 k	5 % 0.063 W 0603
R848	1430009	Chip resistor	220	5 % 0.063 W 0603
R849	1430005	Chip resistor	150	5 % 0.063 W 0603
R850	1430009	Chip resistor	220	5 % 0.063 W 0603
R851	1430001	Chip resistor	100	5 % 0.063 W 0603
R852	1430067	Chip resistor	15 k	5 % 0.063 W 0603
R853	1430171	Chip resistor	68	5 % 0.063 W 0603
R855	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R856	1430045	Chip resistor	2.7 k	5 % 0.063 W 0603
R857	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R858	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R859	1430075	Chip resistor	33 k	5 % 0.063 W 0603
R870	1430013	Chip resistor	330	5 % 0.063 W 0603
R871	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R872	1430087	Chip resistor	100 k	5 % 0.063 W 0603
R873	1430001	Chip resistor	100	5 % 0.063 W 0603
R874	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R876	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R877	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R878	1430019	Chip resistor	560	5 % 0.063 W 0603
R879	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R901	1430151	Chip resistor	10	5 % 0.063 W 0603
R902	1430077	Chip resistor	39 k	5 % 0.063 W 0603
R903	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R904	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R905	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R906	1430151	Chip resistor	10	5 % 0.063 W 0603
R907	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R908	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R909	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R910	1430009	Chip resistor	220	5 % 0.063 W 0603
R911	1430169	Chip resistor	56	5 % 0.063 W 0603
R912	1430151	Chip resistor	10	5 % 0.063 W 0603
R913	1430055	Chip resistor	6.8 k	5 % 0.063 W 0603
R914	1430021	Chip resistor	680	5 % 0.063 W 0603
R915	1430151	Chip resistor	10	5 % 0.063 W 0603
R916	1430077	Chip resistor	39 k	5 % 0.063 W 0603
R917	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R918	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R919	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R920	1430065	Chip resistor	10 k	5 % 0.063 W 0603

R921	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R922	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R923	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R924	1430049	Chip resistor	3.9 k	5 % 0.063 W 0603
R925	1430159	Chip resistor	22	5 % 0.063 W 0603
R926	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R927	1430069	Chip resistor	18 k	5 % 0.063 W 0603
R928	1430001	Chip resistor	100	5 % 0.063 W 0603
R930	1430051	Chip resistor	4.7 k	5 % 0.063 W 0603
R931	1430035	Chip resistor	1.0 k	5 % 0.063 W 0603
R932	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R933	1430043	Chip resistor	2.2 k	5 % 0.063 W 0603
R934	1430169	Chip resistor	56	5 % 0.063 W 0603
R935	1430001	Chip resistor	100	5 % 0.063 W 0603
R936	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R937	1430095	Chip resistor	220 k	5 % 0.063 W 0603
R938	1430009	Chip resistor	220	5 % 0.063 W 0603
R939	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R940	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R941	1430073	Chip resistor	27 k	5 % 0.063 W 0603
R942	1430021	Chip resistor	680	5 % 0.063 W 0603
R943	1430065	Chip resistor	10 k	5 % 0.063 W 0603
R944	1430009	Chip resistor	220	5 % 0.063 W 0603
R945	1430001	Chip resistor	100	5 % 0.063 W 0603
R946	1430159	Chip resistor	22	5 % 0.063 W 0603
R947	1430009	Chip resistor	220	5 % 0.063 W 0603
R948	1430087	Chip resistor	100 k	5 % 0.063 W 0603
C100	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C101	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C102	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C103	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C104	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C105	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C106	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C107	2604495	Tantalum cap.	22 u	20 % 16 V 7.3x4.4x2.8
C108	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C109	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C110	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C111	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C112	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C113	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C114	2320107	Ceramic cap.	10 n	5 % 50 V 0603

C115	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C116	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C117	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C118	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C119	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C120	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C121	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C122	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C123	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C124	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C125	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C126	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C127	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C128	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C129	2604103	Tantalum cap.	4.7 u	20 % 35 V 7.3x4.4x2.8
C130	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C131	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C132	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C133	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C134	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C135	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C136	2604495	Tantalum cap.	22 u	20 % 16 V 7.3x4.4x2.8
C137	2604495	Tantalum cap.	22 u	20 % 16 V 7.3x4.4x2.8
C138	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C139	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C149	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C150	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C151	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C152	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C153	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C154	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C155	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C156	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C157	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C158	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C159	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C160	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C161	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C162	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C163	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C165	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C166	2320107	Ceramic cap.	10 n	5 % 50 V 0603

C167	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C168	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C169	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C170	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C171	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C172	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C173	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C174	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C175	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C177	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C178	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C179	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C180	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C181	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C182	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C183	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C184	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C185	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C187	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C188	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C189	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C191	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C192	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C194	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C196	2310752	Ceramic cap.	10 n	20 % 50 V 0805
C197	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C198	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C199	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C200	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C201	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C202	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C203	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C204	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C205	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C206	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C207	2320097	Ceramic cap.	3.9 n	5 % 50 V 0603
C208	2320097	Ceramic cap.	3.9 n	5 % 50 V 0603
C209	2320043	Ceramic cap.	22 p	5 % 50 V 0603
C210	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C211	2320043	Ceramic cap.	22 p	5 % 50 V 0603
C212	2320097	Ceramic cap.	3.9 n	5 % 50 V 0603
C213	2320059	Ceramic cap.	100 p	5 % 50 V 0603

C214	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C215	2320043	Ceramic cap.	22 p	5 % 50 V 0603
C216	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C217	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C218	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C219	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C250	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C251	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C252	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C253	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C254	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C255	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C256	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C257	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C258	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C259	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C260	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C261	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C262	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C263	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C264	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C265	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C266	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C267	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C268	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C269	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C270	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C300	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C301	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C302	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C304	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C305	2320097	Ceramic cap.	3.9 n	5 % 50 V 0603
C306	2320097	Ceramic cap.	3.9 n	5 % 50 V 0603
C307	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C308	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C309	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C310	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C311	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C313	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C314	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C315	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C316	2310784	Ceramic cap.	100 n	10 % 25 V 0805

C317	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C318	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C319	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C320	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C321	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C322	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C323	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C324	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C325	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C327	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C329	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C350	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C351	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C352	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C353	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C354	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C355	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C356	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C357	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C358	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C359	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C360	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C361	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C702	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C703	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C704	2320035	Ceramic cap.	10 p	5 % 50 V 0603
C705	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C706	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C707	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C709	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C710	2320025	Ceramic cap.	3.9 p	0.25 % 50 V 0603
C711	2320045	Ceramic cap.	27 p	5 % 50 V 0603
C712	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C714	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C715	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C716	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C717	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C718	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C719	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C720	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C721	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C722	2320027	Ceramic cap.	4.7 p	0.25 % 50 V 0603

C725	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C727	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C728	2320055	Ceramic cap.	68 p	5 % 50 V 0603
C729	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C732	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C733	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C734	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C735	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C736	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C738	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C739	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C740	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C741	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C742	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C743	2320348	Ceramic cap.	100 p	2 % 50 V 0603
C744	2320348	Ceramic cap.	100 p	2 % 50 V 0603
C745	2310470	Ceramic cap.	270 p	5 % 50 V 0805
C746	2310470	Ceramic cap.	270 p	5 % 50 V 0805
C747	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C748	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C749	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C750	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C751	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C752	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C753	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C754	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C760	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C761	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C762	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C763	2320021	Ceramic cap.	2.7 p	0.25 % 50 V 0603
C801	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C802	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C803	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C804	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C805	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C806	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C807	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C808	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C809	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C810	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C811	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C812	2320063	Ceramic cap.	150 p	5 % 50 V 0603

C813	2320055	Ceramic cap.	68 p	5 % 50 V 0603
C814	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C815	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C816	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C817	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C818	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C819	2517801	Electrol. cap.	330 u	20 % 25 V 10x10
C820	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C821	2320027	Ceramic cap.	4.7 p	0.25 % 50 V 0603
C822	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C823	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C824	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C825	2320019	Ceramic cap.	2.2 p	0.25 % 50 V 0603
C826	2320035	Ceramic cap.	10 p	5 % 50 V 0603
C827	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C828	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C829	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C830	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C831	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C832	2320021	Ceramic cap.	2.7 p	0.25 % 50 V 0603
C833	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C834	2320464	Ceramic cap.	180 p	5 % 50 V 0603
C835	2320464	Ceramic cap.	180 p	5 % 50 V 0603
C836	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C837	2320027	Ceramic cap.	4.7 p	0.25 % 50 V 0603
C838	2320023	Ceramic cap.	3.3 p	0.25 % 50 V 0603
C839	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C840	2320045	Ceramic cap.	27 p	5 % 50 V 0603
C841	2320035	Ceramic cap.	10 p	5 % 50 V 0603
C842	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C843	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C844	2604495	Tantalum cap.	22 u	20 % 16 V 7.3x4.4x2.8
C845	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C846	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C847	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C848	2604103	Tantalum cap.	4.7 u	20 % 35 V 7.3x4.4x2.8
C849	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C850	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C851	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C852	2320039	Ceramic cap.	15 p	5 % 50 V 0603
C853	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C854	2320049	Ceramic cap.	39 p	5 % 50 V 0603

C855	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C856	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C857	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C858	2320063	Ceramic cap.	150 p	5 % 50 V 0603
C859	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C863	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C864	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C866	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9
C901	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C902	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C903	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C904	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C905	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C906	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C907	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C908	2320043	Ceramic cap.	22 p	5 % 50 V 0603
C909	2320037	Ceramic cap.	12 p	5 % 50 V 0603
C910	2320041	Ceramic cap.	18 p	5 % 50 V 0603
C911	2320045	Ceramic cap.	27 p	5 % 50 V 0603
C912	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C913	2320071	Ceramic cap.	330 p	5 % 50 V 0603
C914	2320031	Ceramic cap.	6.8 p	0.25 % 50 V 0603
C915	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C916	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C917	2604079	Tantalum cap.	0.22 u	20 % 35 V 3.2x1.6x1.6
C918	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C919	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C920	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C921	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C922	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603
C923	2310209	Ceramic cap.	2.2 n	5 % 50 V 1206
C924	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C925	2320059	Ceramic cap.	100 p	5 % 50 V 0603
C926	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C927	2320023	Ceramic cap.	3.3 p	0.25 % 50 V 0603
C928	2320021	Ceramic cap.	2.7 p	0.25 % 50 V 0603
C929	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C930	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C931	2320027	Ceramic cap.	4.7 p	0.25 % 50 V 0603
C932	2320023	Ceramic cap.	3.3 p	0.25 % 50 V 0603
C933	2320049	Ceramic cap.	39 p	5 % 50 V 0603
C934	2320021	Ceramic cap.	2.7 p	0.25 % 50 V 0603

C935	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C936	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C937	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C938	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C939	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C940	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C941	2320107	Ceramic cap.	10 n	5 % 50 V 0603	
C942	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C943	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C944	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603	
C945	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x1.9	
C946	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603	
C947	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C948	2320107	Ceramic cap.	10 n	5 % 50 V 0603	
C949	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603	
C950	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603	
C951	2320107	Ceramic cap.	10 n	5 % 50 V 0603	
C957	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603	
C958	2320083	Ceramic cap.	1.0 n	5 % 50 V 0603	
C959	2320049	Ceramic cap.	39 p	5 % 50 V 0603	
C960	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6	
L100	3641262	Ferrite bead 30r/100mhz 2a	1206		1206
L101	3641262	Ferrite bead 30r/100mhz 2a	1206		1206
L102	3640001	Chip coil 10 u	20 % 1 A 4.5x4x4.5		
L104	3641262	Ferrite bead 30r/100mhz 2a	1206		1206
L105	3641262	Ferrite bead 30r/100mhz 2a	1206		1206
L200	3641302	Chip coil 470 n	5 % Q=30/25 MHz 1008		
L250	3606946	Ferrite bead 0.2r 26r/100mhz 1206			1206
L701	3641522	Chip coil 6. Q n	20 % Q=50/250 MHz 0805		
L702	3641522	Chip coil 6. Q n	20 % Q=50/250 MHz 0805		
L703	3641558	Chip coil 8. Q n	10 % Q=50 0805		
L705	3641622	Chip coil 220 n	5 % Q=30/100 MHz 0805		
L706	3641550	Chip coil 120 n	10 % Q=35/150 MHz 0805		
L707	3641300	Chip coil 330 n	5 % Q=30/25 MHz 1008		
L708	3641300	Chip coil 330 n	5 % Q=30/25 MHz 1008		
L709	3641300	Chip coil 330 n	5 % Q=30/25 MHz 1008		
L710	3641300	Chip coil 330 n	5 % Q=30/25 MHz 1008		
L711	3641550	Chip coil 120 n	10 % Q=35/150 MHz 0805		
L713	3641306	Chip coil 1. Q u	5 % Q=33/25 MHz 1008		
L715	3641526	Chip coil 12.Q n	10 % Q=45/250 MHz 0805		
L801	3641558	Chip coil 8. Q n	10 % Q=50 0805		
L802	3641574	Chip coil 68.Q n	5 % Q=40/200 MHz 0805		

L803	3641558	Chip coil	8. Q n	10 % Q=50 0805	
L804	3641574	Chip coil	68.Q n	5 % Q=40/200 MHz 0805	
L805	3641302	Chip coil	470 n	5 % Q=30/25 MHz 1008	
L806	3641558	Chip coil	8. Q n	10 % Q=50 0805	
L807	3641526	Chip coil	12.Q n	10 % Q=45/250 MHz 0805	
L901	3641306	Chip coil	1. Q u	5 % Q=33/25 MHz 1008	
L902	3641574	Chip coil	68.Q n	5 % Q=40/200 MHz 0805	
L903	3641302	Chip coil	470 n	5 % Q=30/25 MHz 1008	
L904	3641520	Chip coil	3. Q n	20 % Q=50/250 MHz 0805	
L905	3641574	Chip coil	68.Q n	5 % Q=40/200 MHz 0805	
L906	3641520	Chip coil	3. Q n	20 % Q=50/250 MHz 0805	
L907	3641558	Chip coil	8. Q n	10 % Q=50 0805	
L910	3641558	Chip coil	8. Q n	10 % Q=50 0805	
G901	4352804	Vco 1006–1031mhz 4.5v/10ma	gsm		GSM
G902	4510038	SM, VCTCXO 26mhz+–5ppm/–25c/+75c			
Z701	4512001	Dupl 890–915/935–960mhz 39.7x14.8			39.7x14.8
Z702	4550109	Cer.filt 947.5+–12.5mhz	15.5x9.1		15.5x9.1
Z703	4511026	Saw filter 71+–0.08 M	14.2x8.4		
Z704	4510009	Cer.filt 13+–0.09mhz	7.2x3.2		7.2x3.2
Z801	4550107	Cer.filt 902.5+–12.5mhz	11.9x9.5		11.9x9.5
Z802	4557001	Cer.filt 902.5+–12.5mhz	4.8x3.5		4.8x3.5
T700	3640415	Rf–transf. ml 71–130mhz 0.1w 1206			1206
T802	3640417	Rf transf.ml 800/960mhz 0.2w 1206			1206
V100	4107027	Zener diode	BZX84	5 % 16 V 0.3 W SOT23	
V101	4110074	Schottky diode	STPS340U	40 V 3 A SOD6	
V102	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143	
V103	4106769	Zener diode	BZX84	5 % 4.7 V 0.3 W SOT23	
V104	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V105	4200877	Transistor	BCX51–16	pnp 45 V 1.5 A SOT89	
V106	4200877	Transistor	BCX51–16	pnp 45 V 1.5 A SOT89	
V107	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143	
V108	4200877	Transistor	BCX51–16	pnp 45 V 1.5 A SOT89	
V109	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143	
V110	4202456	MosFet	IRFR9020	p–ch 50 V 8 A TO252	
V111	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V112	4103492	Trans. supr.	15V	400 A 5000 W	
V113	4107027	Zener diode	BZX84	5 % 16 V 0.3 W SOT23	
V115	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V117	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23	
V118	4107027	Zener diode	BZX84	5 % 16 V 0.3 W SOT23	
V150	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V151	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	

V152	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V153	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V154	4200877	Transistor	BCX51–16	pnp 45 V 1.5 A SOT89
V155	4210017	Transistor	MJD3055	npn 60 V 10 A TO252
V156	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V157	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V158	4200875	Transistor	BCX54–16	npn 45 V 1.5 A SOT89
V159	4210007	Transistor	MJD2955	pnp 60 V 10 A
V160	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V161	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V162	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V200	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V201	4210079	Transistor	BFS17	npn 15 V 50 mA SOT23
V202	4210079	Transistor	BFS17	npn 15 V 50 mA SOT23
V205	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V250	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V251	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V300	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V301	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V302	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V303	4102998	Led	Green	2.2 V 1206
V304	4102998	Led	Green	2.2 V 1206
V305	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V306	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V307	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V308	4200875	Transistor	BCX54–16	npn 45 V 1.5 A SOT89
V314	4107027	Zener diode	BZX84	5 % 16 V 0.3 W SOT23
V315	4107027	Zener diode	BZX84	5 % 16 V 0.3 W SOT23
V350	4117998	Precision voltage reference	4.096	4.096
V701	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V702	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V703	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V704	4210010	Transistor	BFP183	npn 12 V 65 mA SOT143
V705	4201036	Transistor	BFR93A	npn 12 V 35 mA SOT23
V706	4201036	Transistor	BFR93A	npn 12 V 35 mA SOT23
V707	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V708	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V709	4201036	Transistor	BFR93A	npn 12 V 35 mA SOT23
V801	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23
V802	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23
V803	4110014	Sch. diode x 2	BAS70–07	70 V 15 mA SOT143
V805	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23

V806	4210010	Transistor	BFP183	npn 12 V 65 mA SOT143	
V807	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23	
V808	4201036	Transistor	BFR93A	npn 12 V 35 mA SOT23	
V809	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V810	4210010	Transistor	BFP183	npn 12 V 65 mA SOT143	
V811	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23	
V813	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V901	4110062	Cap. diode	BB535	30 V 2.1/18.7PFSOD323	
V902	4201036	Transistor	BFR93A	npn 12 V 35 mA SOT23	
V903	4200909	Transistor	BC858B/BCW30	pnp 30 V 100 mA SOT23	
V904	4210010	Transistor	BFP183	npn 12 V 65 mA SOT143	
V905	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V906	4210010	Transistor	BFP183	npn 12 V 65 mA SOT143	
V907	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
V908	4200917	Transistor	BC848B/BCW32	npn 30 V 100 mA SOT23	
D200	4372212	IC, ROM	DSP1616–X11	TQFP100	
D201	4346012	IC, SRAM	32kx8 bit 70 ns TSO28		
D202	4346010	IC, SRAM	32kx8 bit 70 ns TSO28		
D250	0240435	MCU ROM SW Module			
	4340122	MCU H8/536 16MHz OTP64KX8 TQFP80			
	8400469	ROM Code			
	9380149	Sticker Brady LAT–2–747 9.5X9.5			
D251	4340146	IC, flash memory	E28F008	TSO40	
D252	4346010	IC, SRAM	32kx8 bit 70 ns TSO28		
D253	4342282	M28c6	4C150 EEPROM 8KX8 150NSTSO2150NSTSO28		
D300	4375070	IC, ESA GSM/PCN ASIC		SQFP144	
D301	4340126	IC, 1xnand 2input cmos	ss	TC7S00F	SSO5
D302	4340126	IC, 1xnand 2input cmos	ss	TC7S00F	SSO5
N100	4375588	IC, PSL+ power supply		SO24W	
N101	4340037	IC, regulator	LM2941S	LD<1 V 1 A TO263	
N102	4301182	IC, 2 x op.amp.	LM2902	SO14S	
N150	4343132	IC, PCM coded/filter	ST5080	SO28W	
N151	4301182	IC, 2 x op.amp.	LM2902	SO14S	
N152	4347948	IC, 2 x op.amp.	LM258	SO8S	
N350	4370015	IC, ASIC	SQFP64		
N701	4349630	IC, v1.4 gsm receiver	vso	PMB2403S	VSO24
N702	4349648	IC, if amp 100mhz	sso	W1466BBL	SSO14
N801	4301062	IC, regulator	LP2951AC	SO8S	
N803	4340301	IC, regulator	TK11550M	5.0 V 0.13 A SO8S	
N804	4345678	IC, 2 x op.amp.	MC33076	SO8S	
N805	4349706	IC, modulator	PMB2200S	VSO20	
N807	4350085	Slm–090a mixer 700–1000mhz			

N808	4347948	IC, 2 x op.amp.	LM258	SO8S	
N901	4349660	IC, PLL	PMB2306T	SO14S	
N902	4349660	IC, PLL	PMB2306T	SO14S	
N903	4342474	IC, prescaler	SA701	SO8S	
N904	4340301	IC, regulator	TK11550M	5.0 V 0.13 A SO8S	
N905	4350037	IC, pow.amp.		12 V 23 W GSM	
N906	4350085	Slm–090a mixer 700–1000mhz			
X002	4510044	Crystal	60.2 M		
X100	5469009	System conn 16pol 2x8 stackered			
X101	5430001	D25–conn 90’deg metal bracket			
X103	5400033	Sim card reader ccm04–5003 6pol			
X104	5420011	Connector mini uhf 90’deg <2.5gh			<2.5GHZ
P001	9854082	PC board GM8	184.5x135.9x1.6 m6 1/pa		
	9854082	PCB GM8 184.5X135.9X1.6 M6 1/PA			