IPAD™ protection and rectifiers for mobile communication

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Contents

Requirements of mobile devices

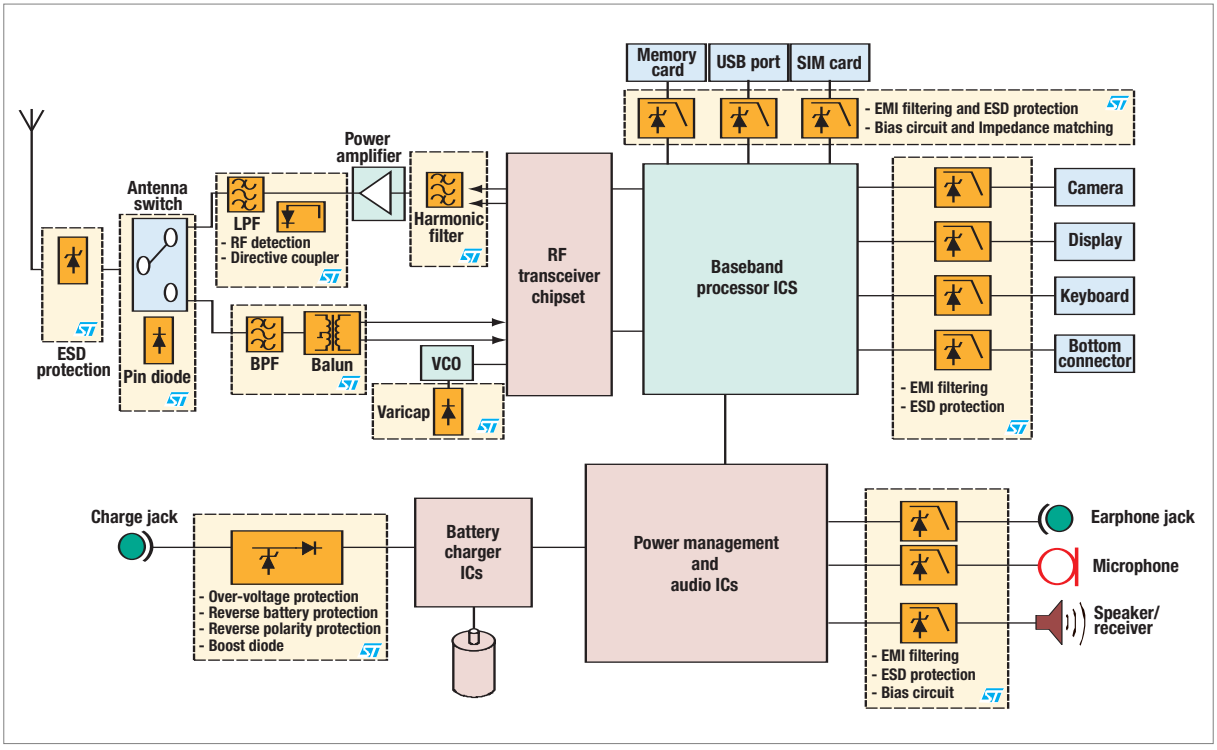
Mobile devices featuring multimedia capability, now incorporate richer, thinner and lighter designs. Such trends need ever-increasing memory size, display quality and data transmission rate, which in turn bring a highly-integrated and compact environment to the mobile device. EMI interference, ESD destruction and space constraint are also key issues which all designers must take into consideration when developing mobile devices.

As a leading semiconductor vendor, **STMicroelectronics** provides the best-in-class discrete and integrated solution (IPAD™) to improve the performance and integration level of the system.

ST's IPAD: the right choice

- N°1 supplier for IPAD and protection devices in the world
- The most complete portfolio to cover all function blocks in mobile device
- Front-end and back-end factory worldwide presence
- Powerful manufacturing operation to guarantee large volume and high standard of delivery
- Over 2 billion units shipped for the portable market
- A wide range of packages, from SOT666 to Flip-Chip, QFN and micro QFN

Mobile phone mapping



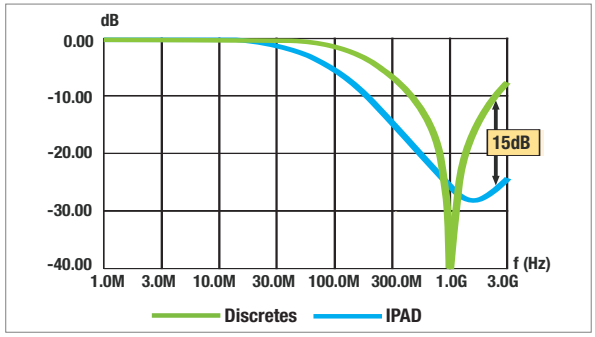
Advantages of IPAD

What's IPAD?

IPAD (integrated passive and active devices) is a highly integrated technology developed by STMicroelectronics, which combines different types of passive and active elements on a monolithic circuit. It represents a further stage in the concept of integration, replacing various discrete components or functions required by the applications, such as ESD protection diodes, EMI filters, line terminations, pull-up or pull-down resistors, signal switches and RF components, etc.

1. Improved EMI filtering performance

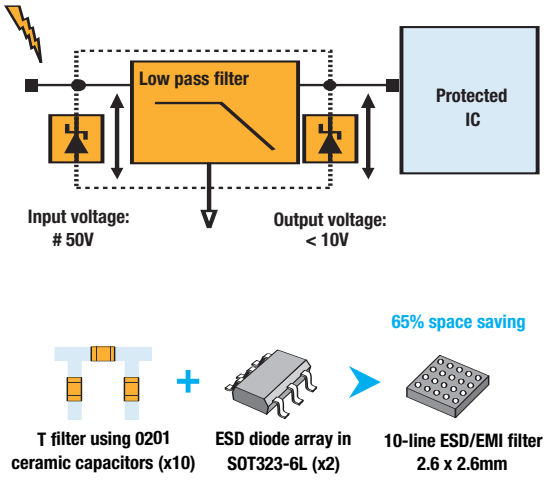
With integrated EMI low pass filters, IPAD technology rejects the high-frequency spectrum that can prevent equipment from passing EMC (electromagnetic compatibility) standards. The figure on the right shows the IPAD filter attenuation performance obtained with EMIF products in comparison with typical discrete passive components. In dual, triple and quad band environments, the level of rejection provided by IPAD solutions is greatly enhanced in comparison to passive solutions.

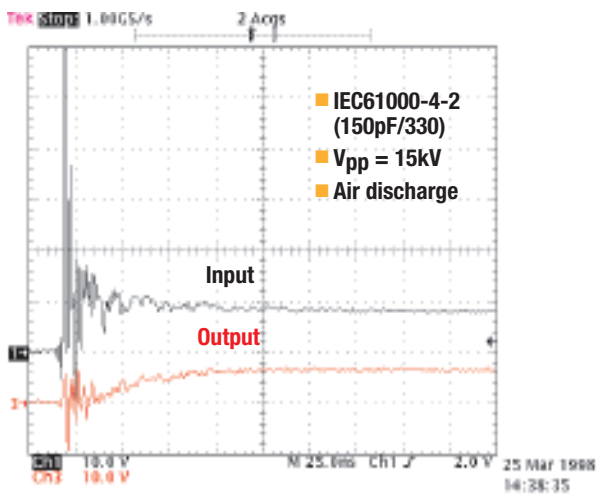


2. Improved ESD protection capability

IPAD technology also provides ESD protection in compliance with IEC61000-4-2 specifications. Due to the integrated double clamping structure, the voltage at the device output is reduced down to 10V when a 15kV surge is applied. The diagram below shows measurement results for a 15kV air discharge applied on an EMIF product.

15kV electrostatic discharge





3. Minimized board space

IPAD products take advantage of integrated passive arrays and networks that were previously used instead of discrete components. In fact space saving is estimated between 50% and 80% when compared to standard discretes. So this technology becomes very attractive when taking into consideration the combined electrical and dimensional performance. A comparison of the space required by a 10 line filter plus ESD protection, between an IPAD and a discrete solution, results in approximately 19mm^2 space board used for the complete discrete solution and only 6.8mm^2 by using the EMIF10-1K010F2 in the Flip-Chip package.

4. Integration capability

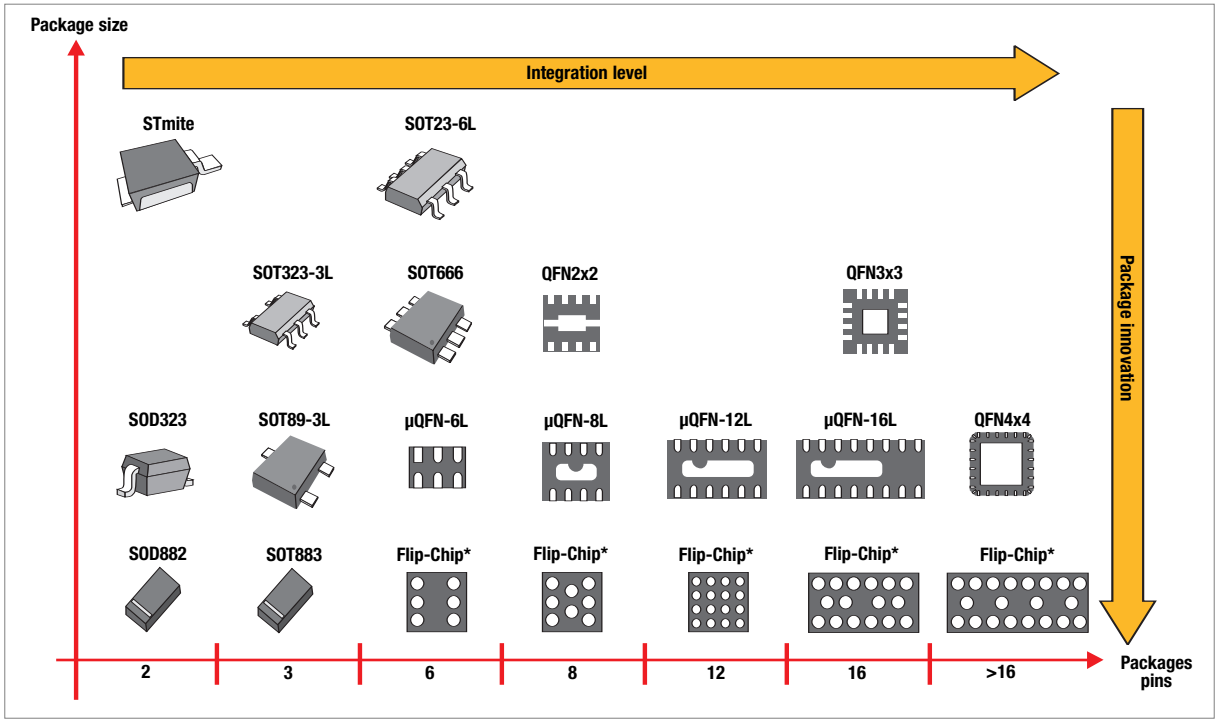
Passive elements	Active elements
Resistors ■ From 1 to 500 k ■ 5%, 10% tolerance ■ Matching <2% **Capacitors** ■ 0.6nF/mm², 20% tolerance ■ High density capacitance, 20% tolerance (1~30nF) **Inductors** ■ Up to ~140nH ■ Low Q factor (<10)	**ESD diodes (IEC61000-4-2 level 4)** ■ 6V and 14V ■ Uni and bidirectional ■ Low capacitance structure **Schottky diodes** ■ 6V signals ■ VF = 0.3 V ■ C < 2pF **Small signal integrated functions** ■ Short circuit protection ■ Temperature and over-current detection ■ Over-voltage limitation ■ Data conditioning

5. Summary

The main benefits of IPAD technology are:

- Superior electrical performance compared to discretes
- Minimized board space
- Reduced component number and increased reliability through a monolithic solution
- Added value by multiple integrated functions
- Cost-effectiveness

Available packages



** 400µm and 500µm pitch Flip-Chip package available*

IPAD and discretes applications mapping

Keypad/MCU

EMI filter
EMIF10-1K010F2
ESD Protection
ESDALC6V1M3
ESDALC6V1-xxM2

LCD screen

EMI Filter
EMIF10-LCD series
EMIF10-COM01F2
EMIF04-2005QCF
EMIF08-2005QEJ
EMIFxx-VID01 series
EMIFxx-1502Mxx

Microphone, speakers and audio lines

EMI Filter
EMIF01-10005W5
EMIF02-MIC series
EMIF02-SPK01F2

Power amplifier control

EMI Filter
STPAC02F2

RF diodes

Pin diode
BAR63J
Detection diode
STDD15
Varicap
STVD901J

Power management

Transil
SM2T series
SMTY18AM
Power schottky
STPS120M
STPS140M
STPS060Z
STPS0540Z
STPS1L20M
STPS1L40M

MMC interface

EMI Filter
EMIF04-MMC02F2
EMIF06-HMC01F2

Bottom connector

EMI Filter
EMIFxx-1005Mxx
EMIF04-10006F2
EMIF06-10006F2
EMIF11-10002C4
EMIF10-1K010F2
ESD Protection
ESDA6V1P6
ESDA6V1-4BF2
ESDA6V1-4F2
ESDA6V1M6
ESDA6V1-5M6

SIM card interface

EMI Filter
EMIF03-SIM series
ESD Protection
ESDALC6V1P6
ESDALC6V1W5
ESDALC6V1M6

USB interface

EMI Filter
EMIF02-USB series
ESD Protection
USBUF01P6
USBUF01W6
USBUF02W6

Application needs

- **EMI suppression and ESD protection**
- **Low total line capacitance**
- **High attenuation at GSM/DCS/CDMA frequency**

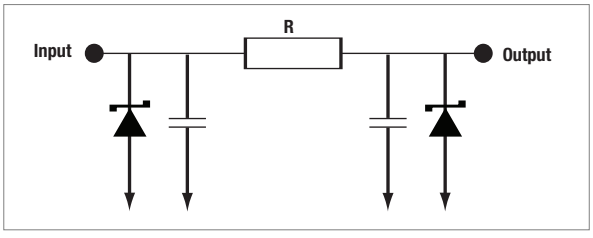
Benefits

- **Widest product range: 4, 6, 8 and 10 lines**
- **Complete package portfolio: Flip-Chip, QFN and micro QFN**
- **Different line capacitances are available to meet specific requirements**
- **All products provide attenuation across a wide frequency band**
- **All products are compliant with ESD immunity according to IEC61000-4-2 level 4**

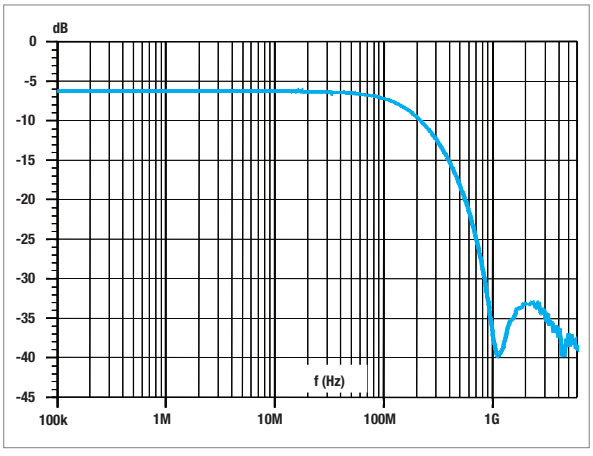
EMIF04/06/08-VID01F2

- 4, 6 and 8 line EMI filtering and ESD protection
- High attenuation filter (-40dB)
- Very low line capacitance (17pF @ 2.5V)
- Flip-Chip package

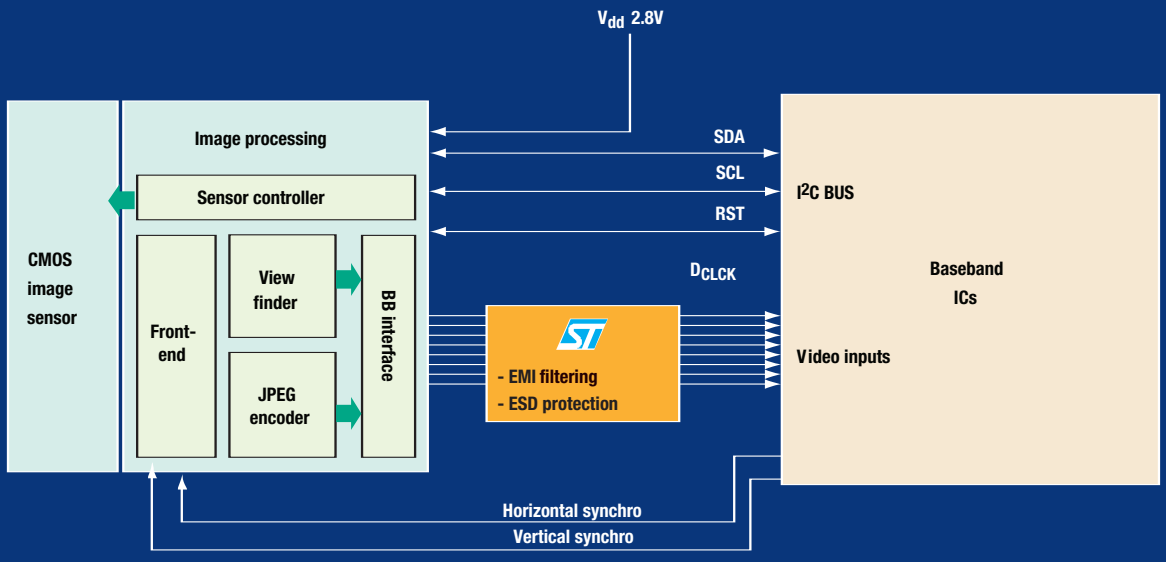
Basic cell configuration



S21 attenuation curve of EMIF08-VID01



LCD and camera



EMIF04-1502M8, EMIF06-1502M12 and EMIF08-1502M16

- 4, 6 and 8 line EMI filtering and ESD protection
- Ultra low line capacitance: 14pF @ 2.5V
- QFN package (0.4mm pitch)

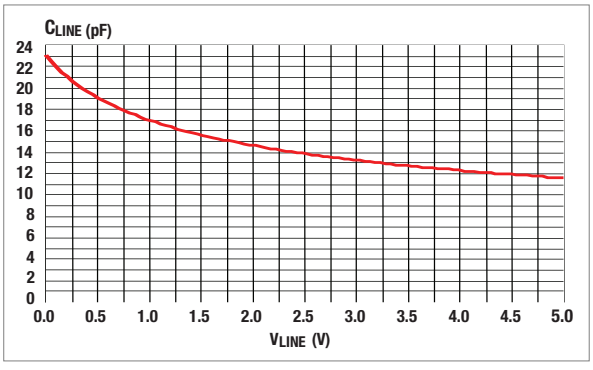
EMIF10-LCD01F2 and EMIF10-COM01F2

- 10 line EMI filtering and ESD protection
- Low or high capacitance (on choice)
- Flip-Chip package

EMIF10-LCD02F3

- 10 line EMI filtering and ESD protection
- Low line capacitance 30pF @ 0V
- Flip-Chip package, 400µm pitch (3.9mm²)

Total line capacitance curve of EMIF04-1502M8



Application needs

- **ESD protection and EMI filtering**
- **High attenuation at GSM/DCS/CDMA frequency**

Benefits

- **Smallest µQFN package available**
- **Reduced component count**
- **Wide frequency range rejection: -30dB from 800MHz to 3GHz**
- **Low capacitance versions available**

ESDA6V1M6 and ESDA6V1-5M6

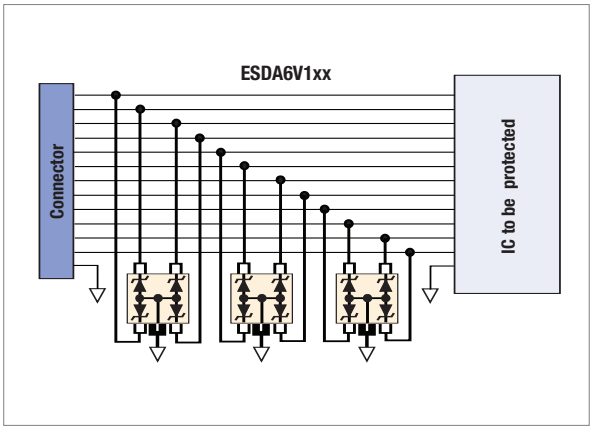
- 4 and 5 line ESD protection
- 100W Peak pulse power (8/20µs)
- Micro QFN-6L package (1.45mm²)

ESDA6V1P6 and ESDA6V1-5P6

- 4 and 5 line ESD protection
- 150W peak pulse power (8/20µs)
- SOT-666 package (2.6mm²)

ESDA6V1-4BF2 and ESDA6V1-4F2

- 4 line uni or bidirectional ESD protection
- 150W peak pulse power (8/20µs)
- Flip-Chip (1.68mm²)



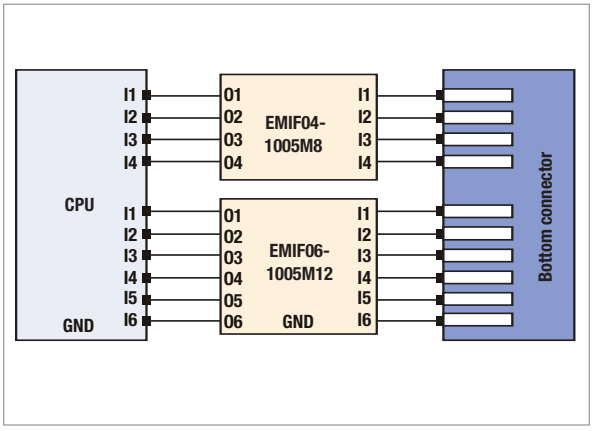
Bottom connector

EMIF0x-1005Mxx

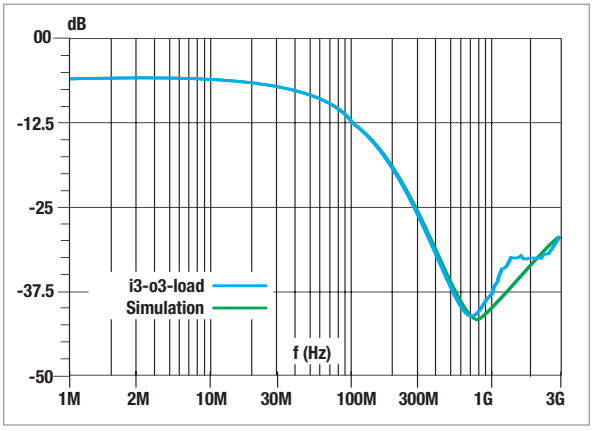
- 4, 6 and 8 line EMI filter + ESD protection
- High attenuation level at mobile phone frequencies
- Micro QFN: 8 leads (2.6mm²), 12 leads (3.8mm²), 16 leads (5.0mm²)

EMIF0x-10006F2

- 4 and 6 line EMI filter + ESD protection
- High attenuation level at mobile phone frequencies
- Flip-Chip package



S21 attenuation curve of EMIF06-1006



Application needs

- **Impedance matching**
- **Pull-up or pull-down resistor**
- **Low line capacitance**
- **EMI suppression and ESD protection**

Benefits

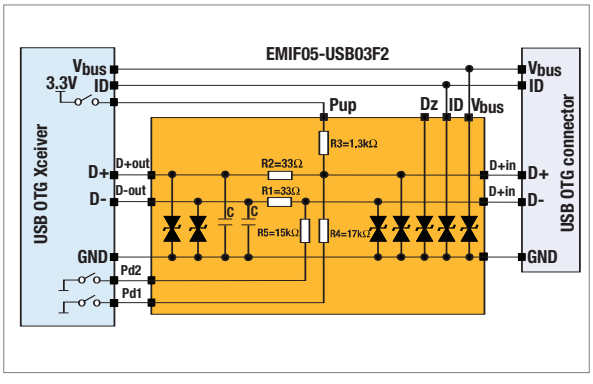
- **Complete portfolio for USB1.1, USB-OTG and USB2.0 standard**
- **Space saving micro packages: Flip-Chip, SOT666**
- **All products are compliant with ESD immunity according to IEC61000-4-2 level 4**

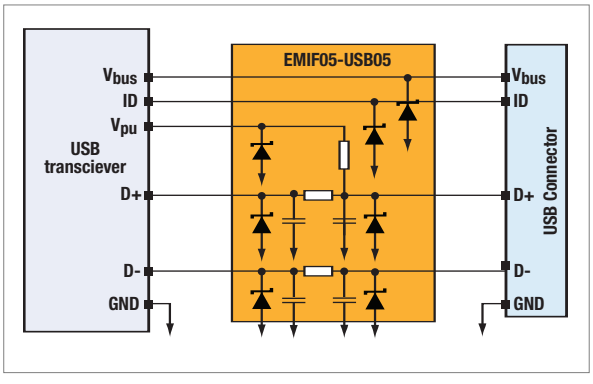
EMIF02-USB03F2

- USB-OTG compatible
- 2 data line EMI filter and ESD protection
- 3 line ESD protection for power and control lines
- Integrated pull-up and pull-down resistors
- C_{line} = 20pF @ 0V
- Flip-Chip package

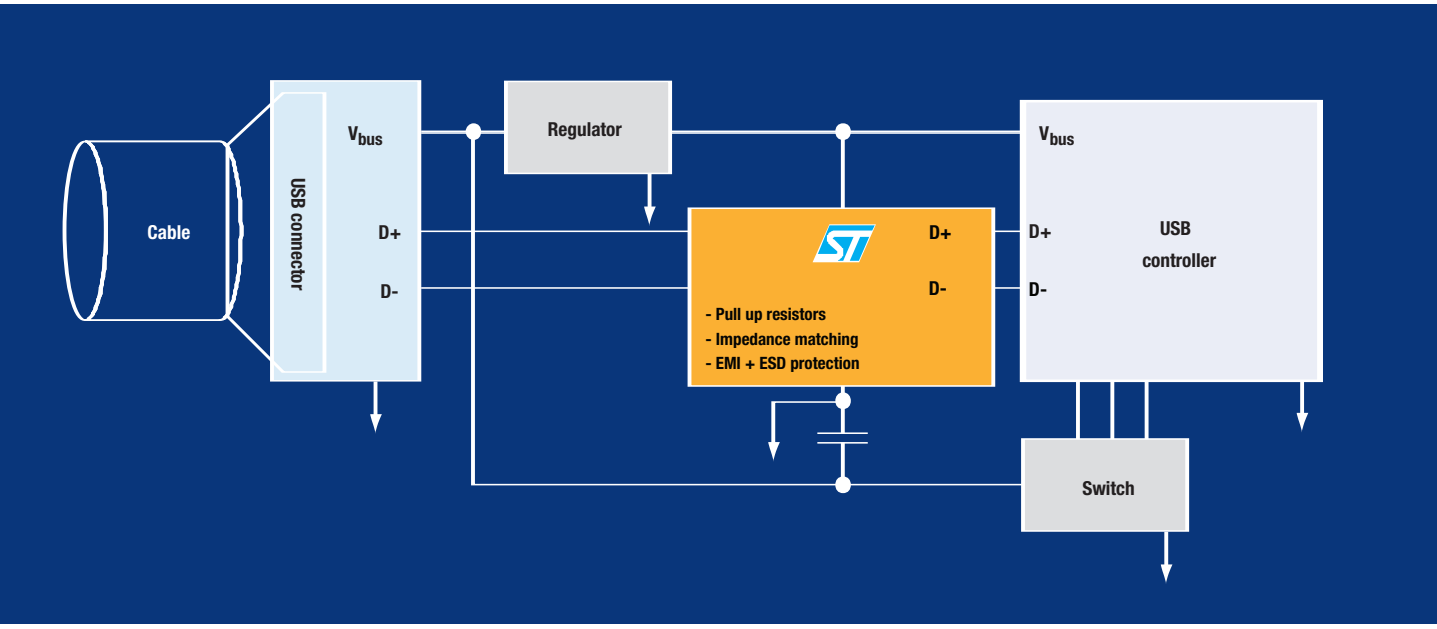
EMIF02-USB05F2

- USB 1.1/OTG low-speed and full-speed compatible
- 2 data line EMI filter and ESD protection
- 3 line ESD protection for power and control lines
- Integrated pull-up resistor
- C_{line} = 30pF @ 0V
- Flip-Chip package





USB interface

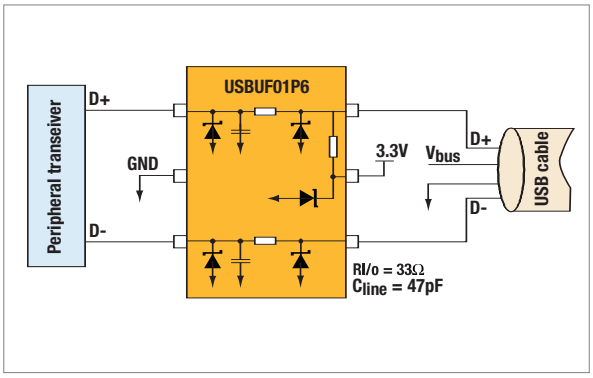


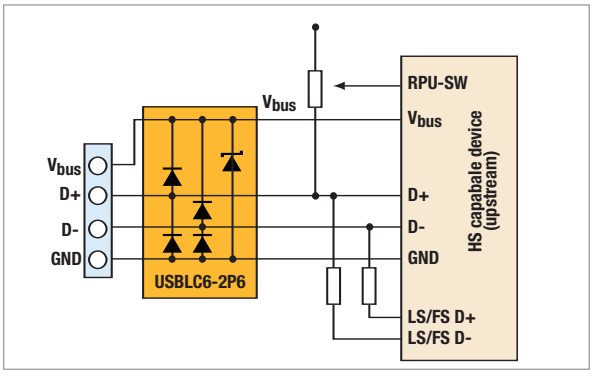
USBUF01P6

- USB1.1 low speed and full-speed compatible
- 2 data lines EMI filter and ESD protection
- V_{cc} protected by integrated ESD diode
- Integrated 1.5 k pull-up resistors
- C_{line} = 47pF @ 0V
- Flip-Chip package

USBLC6-2P6

- USB 2.0/OTG high-speed (480MHz) compatible
- 2 data line ESD protection
- V_{bus} protected by integrated ESD diode
- C_{line} = 2.5pF @ 0V (typical value)
- SOT666 package





Memory card

Application needs

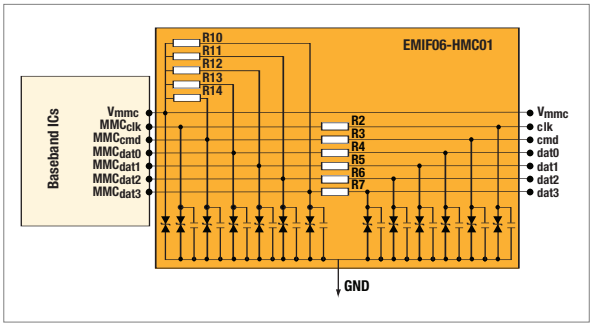
- Impedance matching
- Low line capacitance
- Pull-up or pull-down resistor
- EMI suppression and ESD protection

Benefits

- High-integration in Flip-Chip package
- ESD immunity as per IEC61000-4-2 level 4
- Wide frequency range rejection
- Low capacitance suitable for high data rate interface

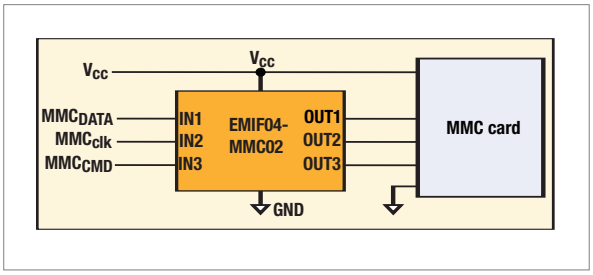
EMIF06-HMC01F2

- 6 line EMI filter and ESD protection
- Integrated pull-up resistors
- ESD protection
- Flip-Chip package (16 bumps, 3.7mm²)



EMIF04-MMC02F2/F3

- 3 line EMI filter and ESD protection
- V_{cc} protected by integrated clamping diode
- Flip-Chip package (500µm/400µm pitch)



SIM card interface

Application needs

- Low line capacitance
- Impedance matching
- V_{CC} ESD protection
- EMI suppression and ESD protection

Benefits

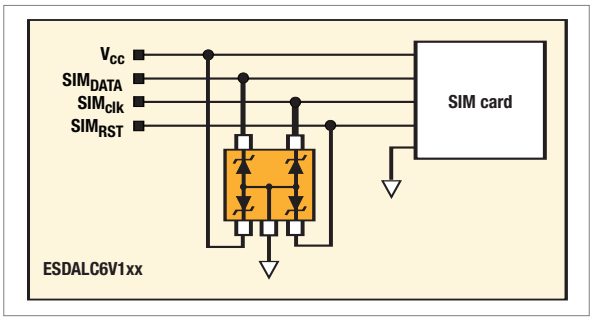
- Low PCB area with SOT666, µQFN and Flip-Chip packages
- ESD immunity according to IEC61000-4-2 level 4
- Low line capacitance
- Wide frequency range rejection: -35dB from 800MHz to 3GHz

ESDALC6V1M6 and ESDALC6V1-5M6

- 4 and 5 line ESD protection
- Low capacitance: 12pF @ 0V
- Micro QFN-6L package (1.45mm²)

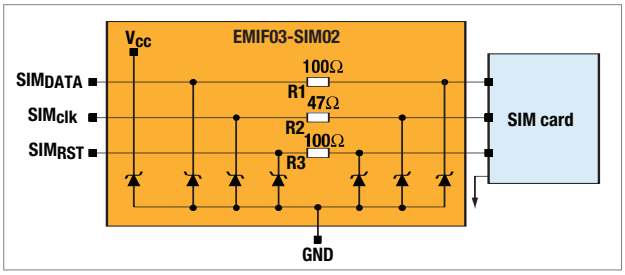
ESDALC6V1P6 and ESDALC6V1-5P6

- 4 and 5 line ESD protection
- Low capacitance: 12pF @ 0V
- SOT666 package (2.6mm²)



EMIF03-SIM02Fx

- 3 line EMI filter and ESD protection
- Low capacitance: 20pF @ 0 V
- V_{cc} protected by integrated TRANSIL™
- Flip-Chip package 500µm pitch (2.0mm²)
- Flip-Chip package 400µm pitch (1.4mm²)



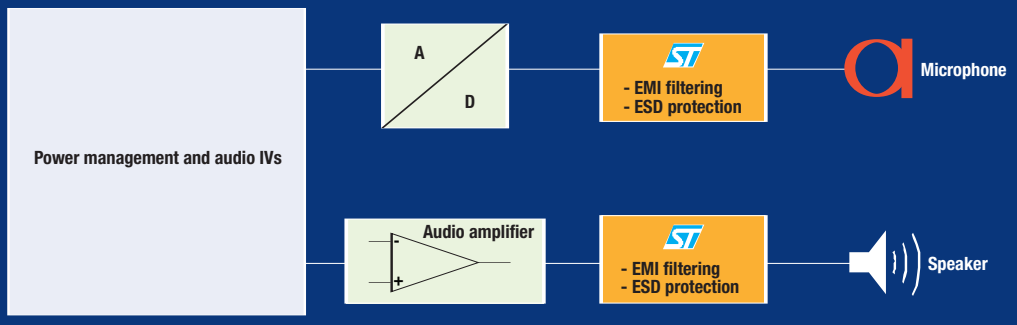
Audio lines (microphone, speaker, receiver, headset)

Application needs

- High level EMI suppression
- Bi-directional ESD protection
- Low insertion loss for speaker/receiver application

Benefits

- High-density capacitance integration capability
- ESD immunity as per IEC61000-4-2 level 4
- High attenuation level at all mobile phone frequencies



EMIF02-MIC02F2

- 2 line EMI filter with ESD protection
- Greater than 30dB attenuation at 900MHz (470Ω /16pF)
- Flip-Chip package (6 bumps, 1.7mm²)

EMIF02-MIC03F2

- 2 line EMI filter with ESD protection
- Greater than 40dB attenuation at 900MHz (68Ω /100pF)
- Flip-Chip package (5 bumps, 1.6mm²)

EMIF01-10005W5

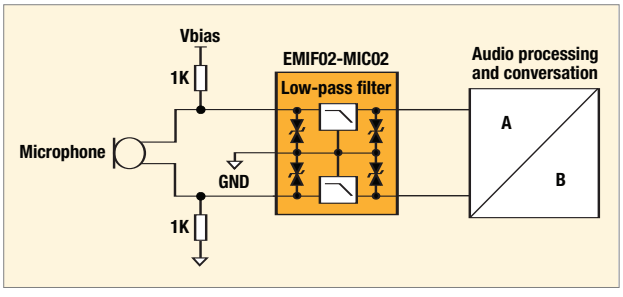
- 2 line EMI filter with ESD protection
- SOT323-5L package

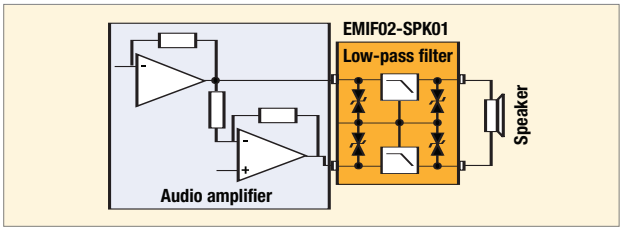
EMIF02-SPK01F2

- 2 line EMI filter with ESD protection
- 10Ω serial impedance
- Flip-Chip package (500µm pitch)

EMIF02-MIC01F2

- 2 line EMI filter with ESD protection
- 50Ω serial impedance
- High density capacitor technology
- Flip-Chip package (500 µm pitch)





EMIF02-MIC04F2 and EMIF02-MIC05F2

- 2 line EMI filter with ESD protection
- Integrated high density capacitor
- 1KΩ serial resistance
- Flip-Chip package (500µm pitch)

Keypad

Application needs

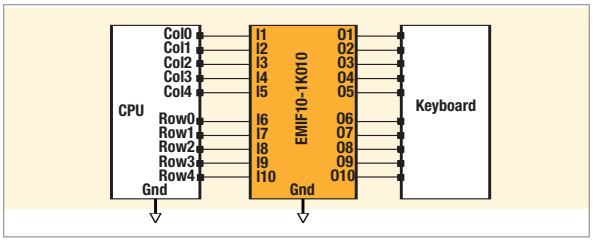
- ESD protection and EMI filtering
- High attenuation at GSM/DCS/CMDA frequency

Benefits

- Market smallest package SOT883 available
- Reduced component count
- Wide frequency range rejection: -30dB from 800MHz to 3GHz

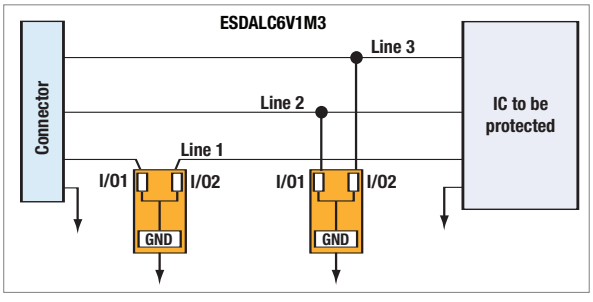
EMIF10-1K010F2

- 10 line EMI filter and ESD protection
- Flip-Chip package (500µm pitch)
- Replaces to 30 discrete devices



ESDALC6V1M3

- 1 or 2 line ESD protection
- Low capacitance: 11pF @ 0V
- SOT883 package (0.6mm^2)



ESDALC6V1-1BM2 and ESDALC6V1-1M2

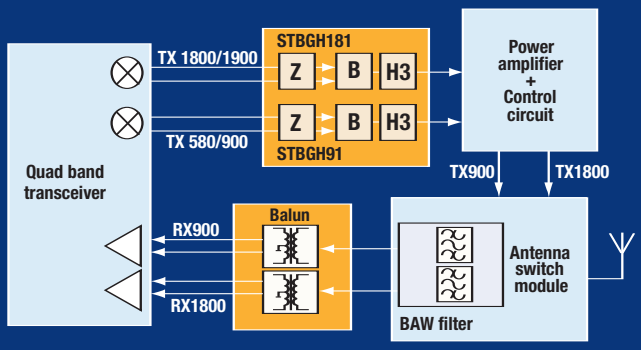
- 1 line ESD protection
- Bi or Uni directional ESD protection
- SOD882 package (0.6mm^2)

Application needs

- RF peak power detection
- Tx harmonic filtering
- PA low pass filtering and directive coupler
- Pin diode for antenna switch module
- Varicap diode for VCO application
- ESD protection for antenna
- Balun

Benefits

- Designed to fit specific wireless requirements
- Design capability for all RF functions
- Improved performance with discretes replacement in RF module
- Space saving with integrated solution



Transmit output filter

STBGH91 and STBGH181 (under development)

- Band pass filter for harmonics generated by RF transceiver
- Pass band of STBGH91: 824 to 915MHz
- Pass band of STBGH181: 1710 to 1910MHz
- Integrated balun for balanced to single-ended conversion
- IPD (integrated passive device) technology on non-conductive glass substrate
- Micro QFN package: 1.5 x 2.3mm^2

Balun

- Outstanding performance (phase and amplitude imbalance)
- Wide frequency band baluns
- Spiral and stacked balun structure
- S-parameter file available
- BAW stacking on baluns
- Ultra small size (0.4 to 0.8mm^2)

Power amplifier module

STPAC02F2

- RF detector for PA control
- Integrated temperature compensation
- Compatible with GSM, CDMA and TDMA
- Flip-Chip package (500µm pitch)

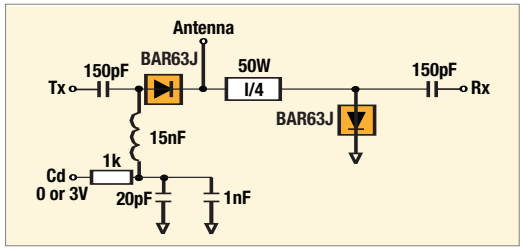
LPF/directive coupler

- Power amplifier output low pass filter
- Integrated or standalone RF directive coupler
- Fewer interconnection losses (die to die bonding)
- Smaller size

RF bock

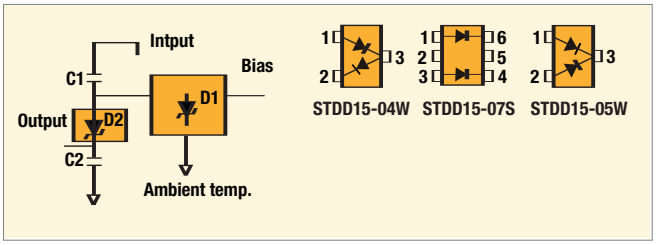
Pin diode
BAR63JFILM

- Pin diode for high-speed switching of RF signal
- Low forward voltage
- Low inductance and low capacitance
- Miniature package SOD-323



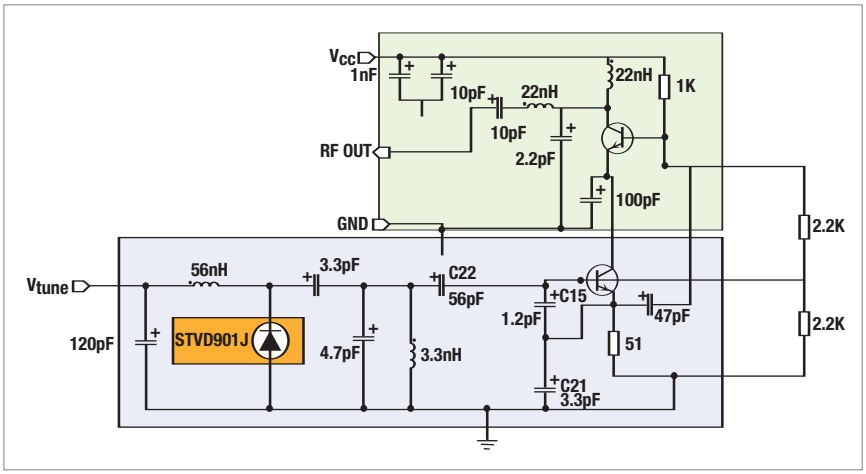
Detection diode
STDD15 series

- Detection and temperature compensated diodes
- Low inductance and low capacitance (1pF @ 0V)
- Three configurations available
- Miniature packages SOT-323 and SOT666

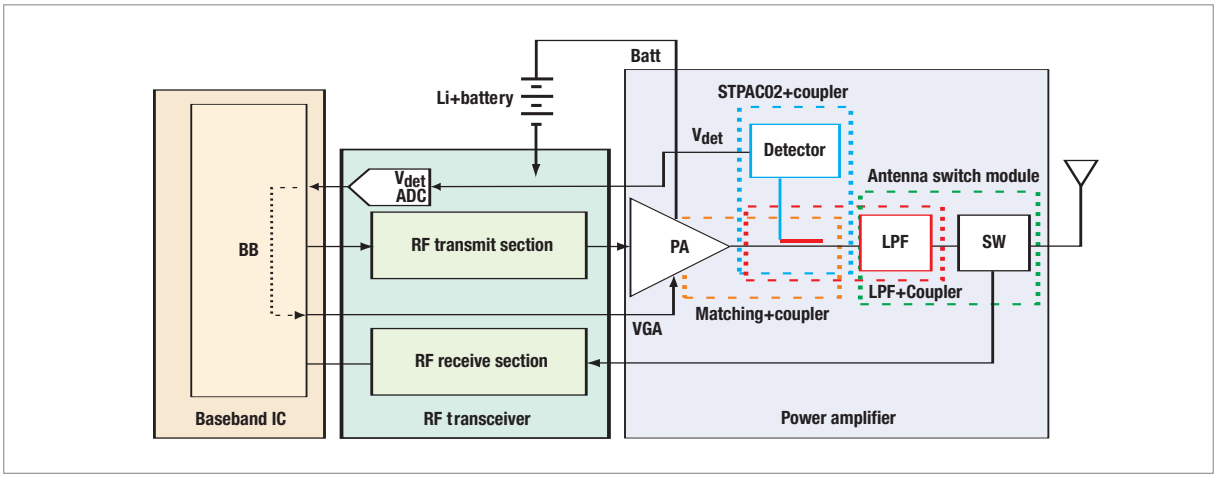


Varicap
STVD901JFILM

- Frequency tuning diode
- High capacitance ratio
- Low inductance 1.5nH
- Low capacitance (4pF @ 0V)
- Miniature package SOD-323



LPF/directive coupler



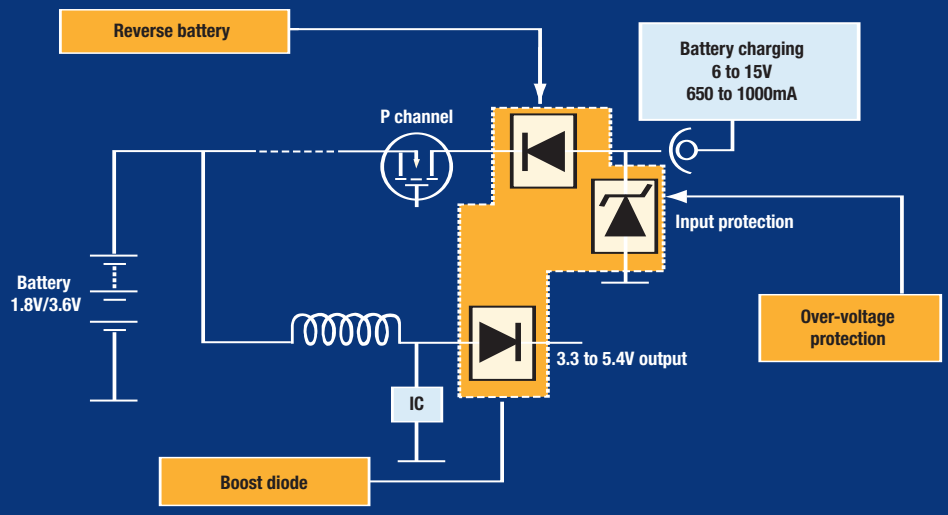
Power management

Application needs

- Overvoltage and reverse polarity protection
- Reverse battery protection
- Boost and buck diode

Benefits

- Converter power losses minimized
- Power supply yield increased
- Optimized thermal performances
- Ultra low profile packages for minimum space



Overvoltage and reverse polarity protection

SMTY18M (Transky™ Diode)

- Integrated overvoltage and reverse polarity protection
- High peak pulse power: 400W (8/20µs)
- Low forward voltage: 0.48V @ 0.85A
- STmite package (7.1mm²)

SM2Txxx

- Transient overvoltage protection diode
- High peak pulse power: 200W @ 10/1000µs
- Wide range of stand off voltage from 5 to 24V
- STmite package (7.1mm²)

Reverse battery

STPS120M and STPS140M

- 1A average forward current
- Peak reverse voltage of 20V and 40V
- STmite package (7.1mm²)

STPS0530Z and STPS0540Z

- 0.5A average forward current
- Peak reverse voltage of 30V and 40V
- SOD-123 (5.8mm²)

Boost diode

STPS1L20M and STPS1L40M

- Low forward voltage: 0.37V max @ 1A
- Peak reverse voltage of 20V
- STmite package (7.1mm²)

Product table

Part number	Main features	Package
LCD, camera and keypad		
EMIF04-VID01xx	4 line filters + ESD level 4; C=16pF; R=100Ω	Flip-Chip
EMIF06-VID01xx	6 line filters + ESD level 4; C=16pF; R=100Ω	Flip-Chip
EMIF08-VID01xx	8 line filters + ESD level 4; C=16pF; R=100Ω	Flip-Chip
EMIF04-1502QCF	4 line filters + ESD level 4; C=13pF; R=160Ω	QFN
EMIF04-1502M8	4 line filters + ESD level 4; C=14pF; R=170Ω	µQFN-8L
EMIF08-1502M12	8 line filters + ESD level 4; C=14pF; R=170Ω	µQFN-12L
EMIF10-1K010F2	10 line filters + ESD level 4; C=100pF; R=1 KΩ	Flip-Chip
EMIF10-COM01F2	10 line filters + ESD level 4; C=45pF, R=200Ω	Flip-Chip
EMIF10-LCD01xx	10 line filters + ESD level 4; C=28pF; R=100Ω	Flip-Chip
EMIF04-2005QCF	4 line filters + ESD level 4; C=45pF; R=200Ω	QFN
EMIF08-2005QEJ	8 line filters + ESD level 4; C=45pF; R=200Ω	QFN
Sim card		
ESDALC6V1M6	4 lines ESD level 4; C=12pF; VBR 6.V	µQFN-6L
ESDALC6V1W5	4 lines ESD level 4; C=12pF; VBR 6.1V	SOT323-5L
ESDALC6V1P6	4 lines ESD level 4; C=12pF; VBR 6.1V	SOT-666
EMIF03-SIM01xx	3 line filters + ESD level 4; C=35pF; R1=R3=100Ω ; R2= 47Ω	Flip-Chip
EMIF03-SIM02xx	3 line filters + ESD level 4; C=20pF; R1=R3=100Ω ; R2= 47Ω	Flip-Chip
Bottom connector		
ESDA6V1M6	4 lines ESD level 4; C=70pF; VBR 6.1V	µQFN-6L
ESDA6V1-5M6	5 lines ESD level 4; C= 70pF; VBR 6.1V	µQFN-6L
ESDA6V1W5	4 lines ESD level 4; C=90pF; VBR 6.1V	SOT323-5L
ESDA6V1-P6	4 lines ESD level 4; C=70pF; VBR 6.1V	SOT666-6L
ESDA6V1-5P6	5 lines ESD level 4; C=70pF; VBR 6.1V	SOT666-6L
ESDA6V1-4F2	4 lines ESD level 4; C=250pF; VBR 6.1V	Flip-Chip
ESDA6V1-4BF2	4 lines ESD level 4; C=30pF, VBR 6.1V	Flip-Chip
EMIF04-10006F2	4 line filters + ESD level 4; C=45pF; R=100Ω	Flip-Chip
EMIF06-10006F2	6 line filters + ESD level 4; C=45pF; R=100Ω	Flip-Chip
EMIF04/06/08-1005M8/M12/M16	4, 6 and 8 line filters + ESD level 4; C=50pF, R=100Ω	µQFN-8L, µQFN-12L, µQFN-16L
USB		
USBUF01W6	2 line filters + ESD level 4; C=47pF; Rs=33Ω ; Rp= 1.5 KΩ	SOT323-6L
USBUF01P6	2 line filters + ESD level 4; C=47pF; Rs=33Ω ; Rp= 1.5 KΩ	SOT666
USBLC6-2P6	2 line filters + ESD level 4 for USB 2.0; C=3.5pF; VBR= 6V	SOT666
EMIF02-USB01xx	2 line filters + ESD level 4; C=50pF; R= 33Ω	Flip-Chip
EMIF02-USB03xx	2 line filters + ESD level 4 for USB OTG; C=20pF Rs=33Ω ; Rp=1.3KΩ	Flip-Chip
EMIF02-USB04xx	2 line filters + ESD level 4; C=40pF; Rs1=Rs; 2=20Ω ; Rs3 =1.5kΩ	Flip-Chip
EMIF02-USB05xx	2 line filters + ESD level 4; C=30pF; Rs=33Ω ; Rp=1.5KΩ	Flip-Chip
Memory card		
EMIF04-MMC02F2	4 line filters + ESD level 4; C=20pF; Rs=47Ω	Flip-Chip
EMIF06-HMC01F2	6 line filters + ESD level 4; C=20pF; Rs=50Ω	Flip-Chip

Continued

Product table (cont'd)

Part number	Main features	Package
Audio		
EMIF01-10005W5	2 line filters + ESD level 4; C=50pF; R=100Ω	Flip-Chip
EMIF02-MIC02F2	2 line filters + ESD level 4; C=16pF; VBR=14V; Rs=470Ω	Flip-Chip
EMIF02-MIC03F2	2 line filters + ESD level 4; C=100pF; VBR=6V; Rs=68Ω	Flip-Chip
EMIF02-SPK01F2	2 line filters + ESD level 4; C=200pF; VBR=6V; Rs=10Ω	Flip-Chip
RF device		
BAR63J	Pin diode; single; C= 0.3pF@0V	SOD-323/SOD-523
BAS70-07S	Detection diode; dual and triple; C=2pF@0V	SOT323-6L
STTD15-xxx	Detection diode;dual; C=1pF@0V	SOT323-6L/SOT-666
STVD901J	Varicap single; C= 4pF@0V; capacitance ratio=2	SOD-323/SOD523
STPAC02F2	Compensated temperature power amplifier control	Flip-Chip
Power management		
STPS0520Z	Power Schottky; 0.5A, 20V; VF=0.32Vmax@0.5A	SOD-123
STPS0540Z	Power Schottky; 0.5A, 20V; VF=0.40Vmax@0.5 A	SOD-123
STPS120M	Power Schottky; 1A, 20V; VF=0.41Vmax@1A	STmite
STPS1L20M	Power Schottky; 1A, 20V low VF; VF=0.37Vmax@1A	STmite
STPS1L30M	Power Schottky; 1A, 30V low VF; VF=0.34Vmax@1A	STmite
STPS1L40M	Power Schottky; 1A, 40V low VF; VF=0.40Vmax@1A	STmite
SMTY18AM	Transky; VRM=16V; VF=0.48Vmax@0.85A	STmite
SM2T series	Transil unidirectional; VRM=5 to 24V; Ppp=200W 10/1000µs	STmite

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