



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

FXLP4555

1.8V / 3.0V SIM Card Power Supply and Level Shifter

Features

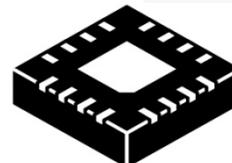
- Supports 1.8V or 3.0V SIM Cards
- LDO Supplies >50mA Under 1.8V and 3.0V
- Built-in Pull-up Resistor for I/O Pin in Both Directions
- ESD Protection: 8kV (Human Body Model, According to ISO-7816 Specifications)
- Supports Clock \geq 5MHz
- Supports “Clock Stop” Power Management per ISO7816-3 Specifications
- Low-Profile 3x3mm MLP-16 Package

Applications

- SIM Card Interface Circuit for 2G, 2.5G, and 3G Mobile Phones
- Identification Module
- Smart Card Readers
- Wireless PC Cards

Description

The FXLP4555 is a level-shifter analog circuit designed to translate the voltages between a SIM card and an external baseband. A built-in LDO-type DC-DC converter allows the FXLP4555 to drive 1.8V and 3.0V SIM cards. The device fulfills the ISO7816-3 smart-card interface standard as well as GSM 11.11 (11.12 and 11.18) and 3G mobile requirements (IMT-2000/3G UICC standard). The EN pin enables a low-current Shutdown Mode that extends battery life. The card power supply voltage (VCC_C) is selected using a single pin (VSEL).



Ordering Information

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
FXLP4555MPX	-40 to +85°C	FXLP 4555	16-Lead, MLP, Quad, JEDEC MO-220, 3MM Square	3000 Units on Tape & Reel

Application Diagram

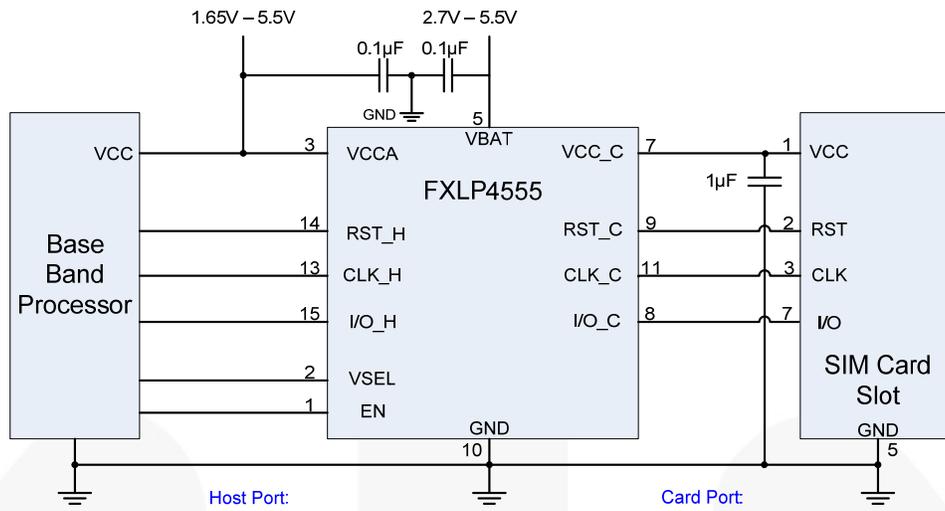


Figure 1. Typical Application

Functional Block Diagram

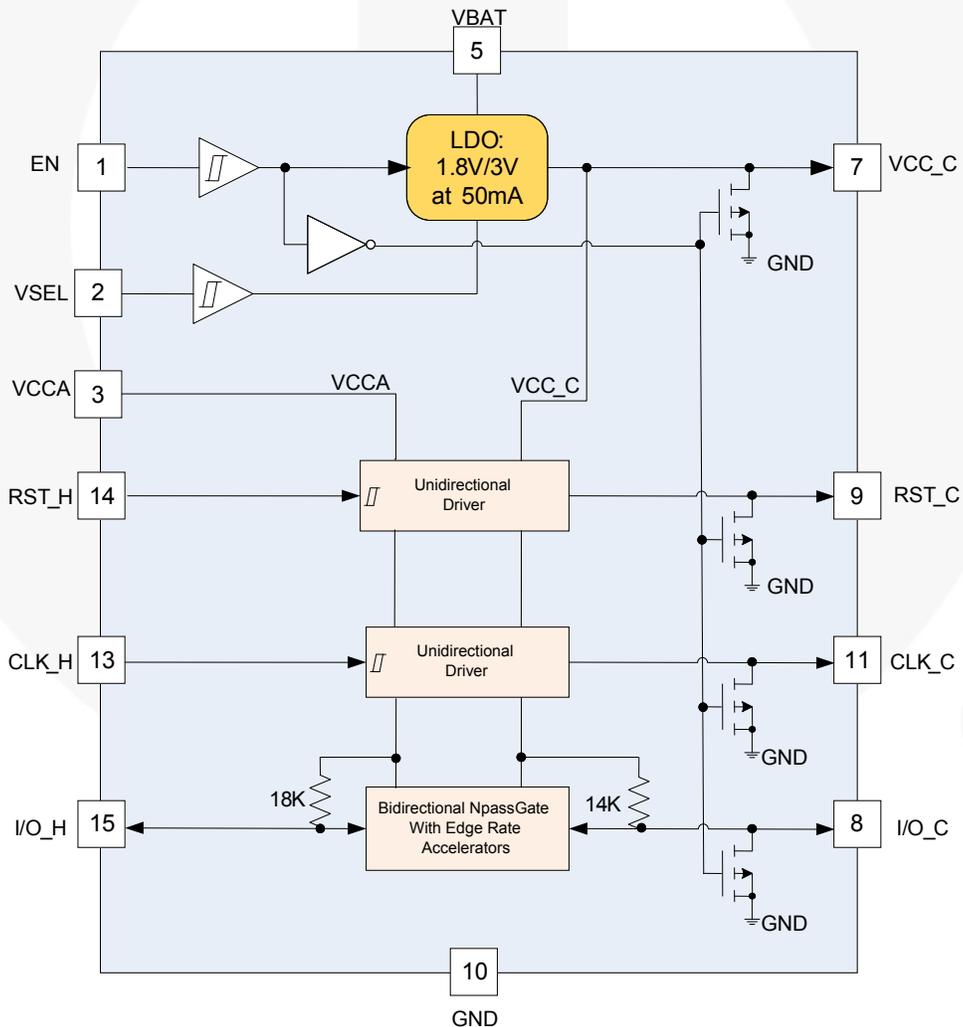


Figure 2. Block Diagram

Pin Configuration

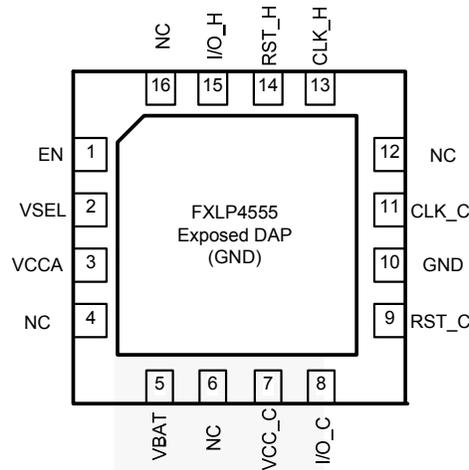


Figure 3. Pin Assignments (Top View)

Pin Definitions

Pin	Name	Type	Description
1	EN	INPUT	Power-Down Mode. EN=LOW → low-current Shutdown Mode activated. EN=HIGH → normal operation. A LOW level on this pin resets the SIM interface, switching off the V_{CC_C} .
2	VSEL	INPUT	The signal present on this pin programs the SIM_V_{CC} value: VSEL=LOW → $SIM_V_{CC}=1.8V$; VSEL=HIGH → $SIM_V_{CC}=3V$.
3	VCCA	POWER	Connected to the baseband power supply; this pin configures the level shifter input stage to accept signals from the baseband. A $0.1\mu F$ capacitor is used to bypass the power supply voltage. When V_{CCA} is below 1.1V (typical), the V_{CC_C} (SIM Card V_{CC}) is disabled and FXLP4555 enters Shutdown Mode.
4	NC		No connect. It is recommended to solder to PCB GND.
5	VBAT	POWER	LDO converter supply input. The input voltage ranges from 2.7V to 5.5V. This pin needs to be bypassed by a $0.1\mu F$ capacitor.
6	NC		No connect. It is recommended to solder to PCB GND.
7	VCC_C	POWER	Connected to the SIM card power supply pin. An internal LDO converter is programmable by the external baseband to supply either 1.8V or 3.0V output voltage. An external $1.0\mu F$ minimum ceramic capacitor must be connected across V_{CC_C} and GND. During a normal operation, the V_{CC_C} voltage can be set to 1.8V, followed by a 3.0V value, or can start directly at either of these values.
8	I/O_C	INPUT/ OUTPUT	Handles the connection to the serial I/O of the card connector. A bi-directional level translator adapts the serial I/O signal between the card and the baseband. A $14k\Omega$ (typical) pull-up resistor provides a high-impedance state for the SIM card I/O link.
9	RST_C	OUTPUT	Connected to the RESET pin of the card connector. A level translator adapts the external reset (RST) signal to the SIM card.
10	GND	GROUND	Ground reference for the integrated circuit and associated signals. Care must be taken to avoid voltage spikes when the device operates in normal operation.
11	CLK_C	OUTPUT	Connected to the CLOCK pin of the card connector. The CLOCK (CLK) signal comes from the external clock generator; the internal level shifter adapts the voltage defined for the V_{CC_C} .
12	NC		No connect. It is recommended to solder to PCB GND.
13	CLK_H	INPUT	The clock signal, coming from the external controller, must have a duty cycle within the range defined by the specification (typically 50%). The built-in level shifter translates the input signal to the external SIM card CLK input.

Pin Definitions (Continued)

Pin	Name	Type	Description
14	RST_H	INPUT	The RESET signal present at this pin is connected to the SIM card through the internal level shifter, which translates the level according to the V_{CC_C} programmed value.
15	I/O_H	INPUT/ OUTPUT	This pin is connected to the baseband. A bidirectional level translator adapts the serial I/O signal between the smart card and the baseband. A built-in constant 18k Ω (typical) resistor provides a high-impedance state when not activated.
16	NC		No connect. It is recommended to solder to pcb GND.
17	Exposed DAP	Ground	Must be soldered to PCB ground plane.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. $T_A=+25^{\circ}\text{C}$.

Symbol	Parameter		Min.	Typ.	Max.	Unit
V_{BAT}	LDO Power Supply Voltage		-0.5	V_{BAT}	6.0	V
V_{CCA}	Power Supply from Baseband Side		-0.5	V_{CCA}	6.0	V
V_{CC_C}	External Card Power Supply		-0.5	V_{CC_C}	6.0	V
V_{IN}	Digital Input Pin Voltage		-0.5	V_{IN}	$V_{CCA}+0.5$, but <6.0	V
I_{IN}	Digital Input Pin Current		-5		+5	mA
V_{OUT}	Digital Output Pin Voltage		-0.5	V_{OUT}	$V_{CCA}+0.5$, but <6.0	V
I_{OUT}	Digital Output Pin Current		-10		+10	mA
V_{OUT_SIM}	SIM Card Output Pin Voltage		-0.5	V_{OUT}	$SIM_V_{CC}+$ $0.5 < 6.0$	V
I_{OUT_SIM}	SIM Card Output Pin Current ⁽¹⁾				15	mA
P_D	Power Dissipation at $T_A=+85^{\circ}\text{C}$				440	mW
Θ_{JA}	Thermal Resistance, Junction-to-Air				72	$^{\circ}\text{C}/\text{W}$
T_A	Operating Ambient Temperature Range		-40		+85	$^{\circ}\text{C}$
T_J	Operating Junction Temperature Range		-40		+125	$^{\circ}\text{C}$
T_{JMAX}	Maximum Junction Temperature				+125	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range		-65		+150	$^{\circ}\text{C}$
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114 $R=1500\Omega$, $C=100\text{pF}$	SIM Card Pins (7,8,9,10,11)	8000		V
			All Other Pins	2000		
		Charged Device Model, JESD22-C101	SIM Card Pins (7,8,9,10,11)	2000		
			All Other Pins	600		
Moisture Sensitivity Level			1		Level	

Notes:

- Internally limited.
- Meets or exceeds JEDEC specification EIA/JESD78 IC latchup test.

Electrical Characteristics

$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$. Device meets the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Power Supply Section						
V_{BAT}	Power Supply		2.7		5.5	V
$I_{V_{BAT}}$	Operating Current	$I_{CC}=0\text{mA}$, $V_{BAT} > 3.0\text{V}$ if $V_{SEL}=1$ or $V_{BAT} > 2.7\text{V}$ if $V_{SEL}=0$		16	25	μA
$I_{V_{BAT_SD}}$	Shutdown Current	EN=Low			3	μA
V_{CCA}	Operating Voltage		1.65		5.50	V
$I_{V_{CCA}}$	Operating Current ⁽³⁾	fCLK=1MHz		7	12	μA
$I_{V_{CCA_SD}}$	Shutdown Current	EN=Low			1	μA
V_{CCA}	Under-Voltage Lockout		0.6		1.5	V
V_{CC_C}	SIM Card Supply Voltage	$V_{SEL}=\text{High}$, $V_{BAT}=3.0\text{V}$, $I_{V_{CC_C}}=50\text{mA}$		2.8		V
		$V_{SEL}=\text{High}$, $V_{BAT}=3.3\text{V} - 5.5\text{V}$, $I_{V_{CC_C}}=0\text{mA} - 50\text{mA}$	2.8	3.0	3.2	
		$V_{SEL}=\text{Low}$, $V_{BAT}=2.7\text{V} - 5.5\text{V}$, $I_{V_{CC_C}}=0\text{mA} - 50\text{mA}$	1.7	1.8	1.9	
$I_{V_{CC_C_SC}}$	Short-Circuit Current	V_{CC_C} Shorted to Ground, $T_A=25^\circ\text{C}$			175	mA
Digital Input / Output Section (CLK, RST, I/O, EN, VSEL)						
V_{IN}	Input Voltage Range	EN, VSEL, RST_H, CLK_H, I/O_H	0		V_{CCA}	V
I_{IH} , I_{IL}	Input Current	EN, VSEL, RST_H, CLK_H	-100		100	nA
V_{IH}	High Level Input Voltage	RST_H, CLK_H, EN, VSEL	$0.7 \cdot V_{CCA}$		V_{CCA}	V
V_{IL}	Low Level Input Voltage	RST_H, CLK_H			$0.2 \cdot V_{CCA}$	V
		EN, VSEL	0		0.4	
$V_{OH_I/O}$	High Level Output Voltage	$I/O_C=V_{CC_C}$, $I_{OH_I/O}=-20\mu\text{A}$	$0.7 \cdot V_{CCA}$		V_{CCA}	V
$V_{OL_I/O}$	Low Level Output Voltage	$I/O_C=0\text{V}$, $I_{OL_I/O}=200\mu\text{A}$	0		0.4	V
I_{IH}	High Level Input Current	I/O	-20		20	μA
I_{IL}	Low Level Input Current	I/O			1.0	mA
R_{pu_I/O_H}	I/O Pull-Up Resistor		12	18	24	k Ω

Continued on the following page...

Electrical Characteristics (Continued)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
SIM Interface Section⁽⁴⁾						
RST_C	V _{CC_C} = +3.0V (V _{SEL} = HIGH)	Output RST_C V _{OH} at I _{RST_C} = -20μA	0.9 • V _{CC_C}		V _{CC_C}	V
		Output RST_C V _{OL} at I _{RST_C} = +200μA	0		0.4	V
		Output RST_C Rise Time at C _{OUT} = 30pF (10% - 90%) ⁽³⁾			1	μs
		Output RST_C Fall Time at C _{OUT} = 30pF (90% - 10%) ⁽³⁾			1	μs
	V _{CC_C} = +1.8V (V _{SEL} = LOW)	Output RST_C V _{OH} at I _{RST_C} = -20μA	0.9 • V _{CC_C}		V _{CC_C}	V
		Output RST_C V _{OL} at I _{RST_C} = +200μA	0		0.4	V
		Output RST_C Rise Time at C _{OUT} = 30pF (10% - 90%) ⁽³⁾			1	μs
		Output RST_C Fall Time at C _{OUT} = 30pF (90% - 10%) ⁽³⁾			1	μs
CLK_C	V _{CC_C} = +3.0V (V _{SEL} = HIGH)	Output Duty Cycle	40		60	%
		Maximum Output Frequency	5			MHz
		Output V _{OH} at I _{CLK_C} = -20μA	0.9 • V _{CC_C}		V _{CC_C}	V
		Output V _{OL} at I _{CLK_C} = +200μA	0		0.4	V
		Output CLK_C Rise Time at C _{OUT} = 30pF (10% - 90%) ⁽³⁾			18	ns
		Output CLK_C Fall Time at C _{OUT} = 30pF (90% - 10%) ⁽³⁾			18	ns
	V _{CC_C} = +1.8V (V _{SEL} = LOW)	Output Duty Cycle	40		60	%
		Maximum Output Frequency	5			MHz
		Output V _{OH} at I _{CLK_C} = -20μA	0.9 • V _{CC_C}		V _{CC_C}	V
		Output V _{OL} at I _{CLK_C} = +200μA	0		0.4	V
		Output CLK_C Rise Time at C _{OUT} = 30pF (10% - 90%) ⁽³⁾			18	ns
		Output CLK_C Fall Time at C _{OUT} = 30pF (90% - 10%) ⁽³⁾			18	ns

Continued on the following page...

Electrical Characteristics (Continued)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
I/O_C	V _{CC_C} =+3.0V (V _{SEL} =HIGH)	Output V _{OH} at I _{I/O_C} =-20μA, V _{I/O} =V _{DD}	0.8 • V _{CC_C}		V _{CC_C}	V
		Output V _{OL} at I _{I/O_C} =+1mA, V _{I/O} =0V	0		0.4	V
		I/O_C Rise Time at C _{OUT} =30pF (10% - 90%) ⁽³⁾			1	μs
		I/O_C Fall Time at C _{OUT} =30pF (90% - 10%) ⁽³⁾			1	μs
	V _{CC_C} =+1.8V (V _{SEL} =LOW)	Output V _{OH} at I _{I/O_C} =-20μA, V _{I/O} =V _{DD}	0.8 • V _{CC_C}		V _{CC_C}	V
		Output V _{OL} at I _{I/O_C} =+1mA, V _{I/O} =0V	0		0.3	V
		I/O_C Rise Time at C _{OUT} =30pF (10% - 90%) ⁽³⁾			1	μs
		I/O_C Fall Time at C _{OUT} =30pF (90% - 10%) ⁽³⁾			1	μs
R _{pu_I/O_C}	Card I/O Pull-Up Resistor		10	14	18	kΩ

Notes:

3. Guaranteed by design over the specified operating temperature range.
4. All the dynamic specifications (AC specifications) are guaranteed by characterization over the specified operating temperature range, unless otherwise indicated.

Typical Performance Characteristics

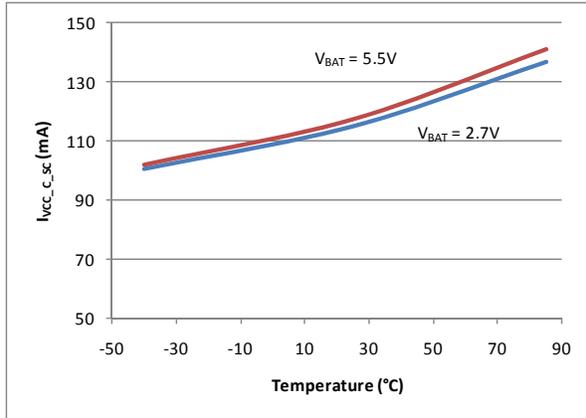


Figure 4. Short-Circuit Current, (I_{VCC_C_SC}) vs. Temperature V_{CC_C}=1.8V (V_{SEL}=LOW)

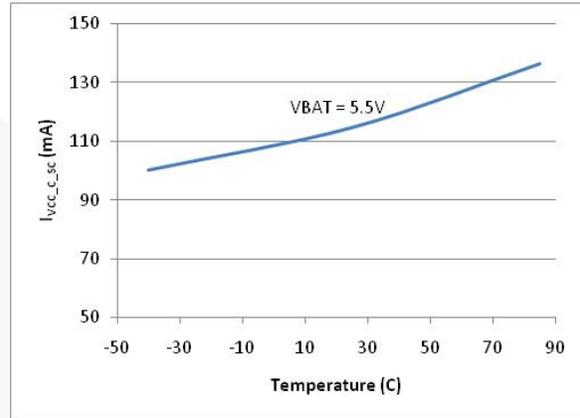


Figure 5. Short-Circuit Current, (I_{VCC_C_SC}) vs. Temperature V_{CC_C}=3.0V (V_{SEL}=HIGH)

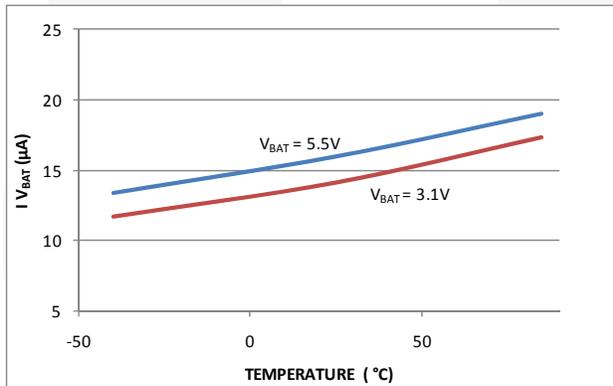


Figure 6. I_{VBAT} vs. Temperature at V_{CC_C}=3.0V (V_{SEL}=HIGH)

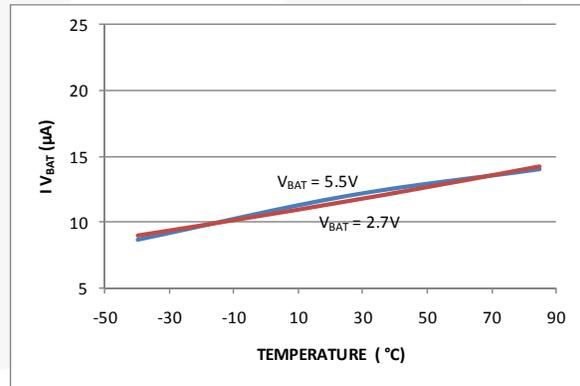


Figure 7. I_{VBAT} vs. Temperature at V_{CC_C}=1.8V (V_{SEL}=LOW)

Application Information

Card Supply Converter

The FXLP4555 interface DC-DC converter is a Low Dropout (LDO) voltage regulator capable of supplying a current in excess of 50mA under 1.8V or 3.0V. Quiescent current is typically lower than 20 μ A (see *Figure 6 and Figure 7*). VSEL is a select input, allowing a logic level signal to select a regulated voltage of 1.8V (VSEL = LOW) or 3.0V (VSEL = HIGH).

FXLP4555 has a shutdown input (EN) that allows it to turn off or turn on the regulator output. Figure 8 shows a simplified view of the voltage regulator. The V_{CC_C} output is internally current limited and protected against short circuits. The short-circuit current (I_{VCC_C_SC}) is constant over the SIM Card V_{CC} and V_{BAT}, while it varies with operating temperature, typically in the range of 90mA to 140mA (Figure 4 and Figure 5).

To guarantee a stable LDO, the V_{CC_C} output is connected to a 1.0 μ F bypass ceramic capacitor to ground. At the input, V_{BAT} is bypassed to ground with a 0.1 μ F ceramic capacitor.

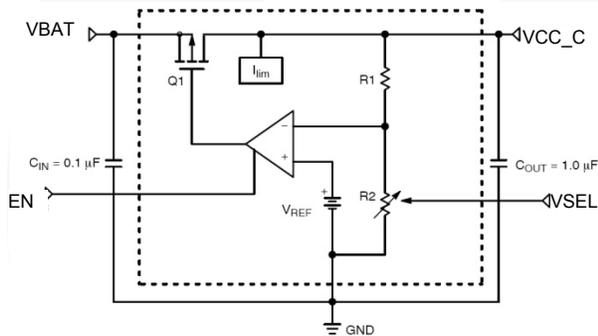


Figure 8. Simplified Block Diagram of the LDO Voltage Regulator

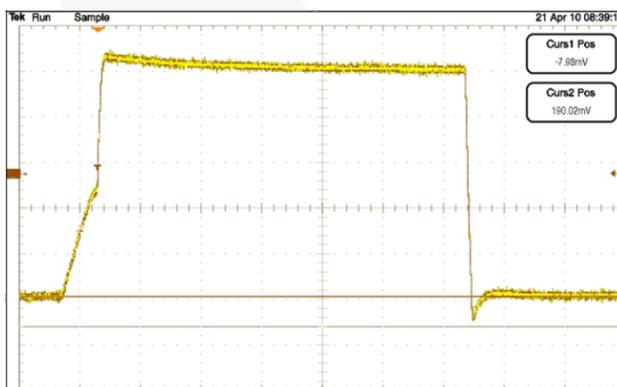


Figure 10. SIM_IO Typical Rise and Fall Times with Stray Capacitance > 30pF (33pF Capacitor Connected on the Board)

Level Shifters

The level shifters accommodate any voltage difference between the Baseband (BB) Processor (1.65V – 5.5V) and the SIM card (1.8V or 3V). The RESET and CLOCK level shifters are uni-directional (from BB to SIM).

The bidirectional I/O line automatically adapts the voltage difference between the baseband and the SIM card in both directions. In addition, with the pull-up resistor, an active edge rate accelerator circuit (see *Figure 9*) provides a fast charge of the stray capacitance, yielding a rise time within the ISO7816-3 specifications.

The typical waveform provided in Figure 10 shows how the accelerator operates. Two distinct slew rates are observed. From 0V to approximately V_{CC}/2, the slew rate is the RC time constant of the pull-up resistor and the stray capacitance. When the input slope crosses the V_{CC}/2 threshold, the edge rate accelerator is activated, resulting in the faster slew rate from approximately V_{CC}/2 to V_{CC} as depicted in Figure 10.

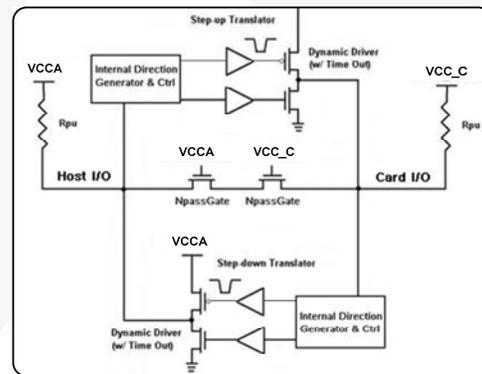


Figure 9. Basic I/O Line Interface

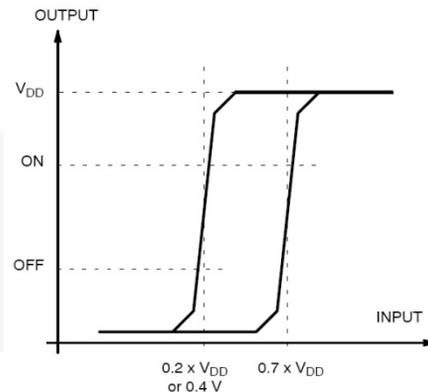


Figure 11. Typical Schmitt Trigger Characteristics

Applications Information (Continued)

Input Schmitt Triggers

All the logic input pins (except I/O_H and I/O_C) have built-in Schmitt trigger circuits to prevent uncontrolled operation. Typical dynamic characteristics of the related pins are depicted in Figure 11.

The output signal is guaranteed to go HIGH when the input voltage is above $0.7 \times V_{DD}$ and go LOW when the input voltage is below $0.4V$. See *Electrical Characteristics* section.

Shutdown Operating

To save power, it is possible to put the FXLP4555 in Shutdown Mode by setting the pin EN LOW. The device enters Shutdown Mode automatically when V_{CCA} goes lower than $1.1V$ typically.

ESD Protection

The FXLP4555 SIM interface features an HBM ESD voltage protection in excess of $7kV$ for all the SIM pins (IO_C, CLK_C, RST_C, VCC_C and GND). All the other pins (Host side) sustain at least $2kV$. The HBM ESD voltage required by the ISO7816 standard is $4kV$.

Printed Circuit Board (PCB) Layout

Careful layout routing should be applied to achieve efficient operating of the device in its mobile or portable environment and to fully exploit its performance.

The bypass capacitors must be connected as close as possible to the device pins (VCC_C , $VCCA$, or $VBAT$) to reduce possible parasitic behaviors (ripple and noise). It is recommended to use ceramic capacitors.

The exposed pad should be connected to ground as well as the unconnected pins (NC). A relatively large ground plane is recommended.

Clock Stop

Section 6.3.2 of ISO7816-3 identifies the “Power Management” feature of Clock Stop. For cards supporting Clock Stop, when the interface device expects no transmission from the card and when I/O has remained at state H for at least 1,860 clock cycles (delay t_g), then according to Figure 13, the interface device may stop the clock on CLK (at time t_e) while the SIM card V_{CC} remains powered and RST at state H.

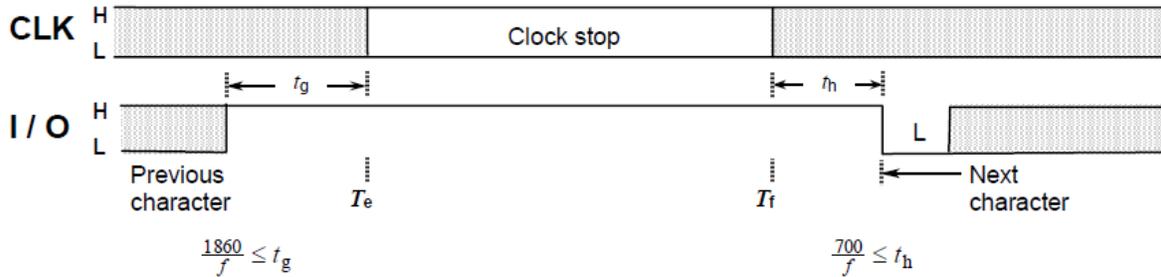


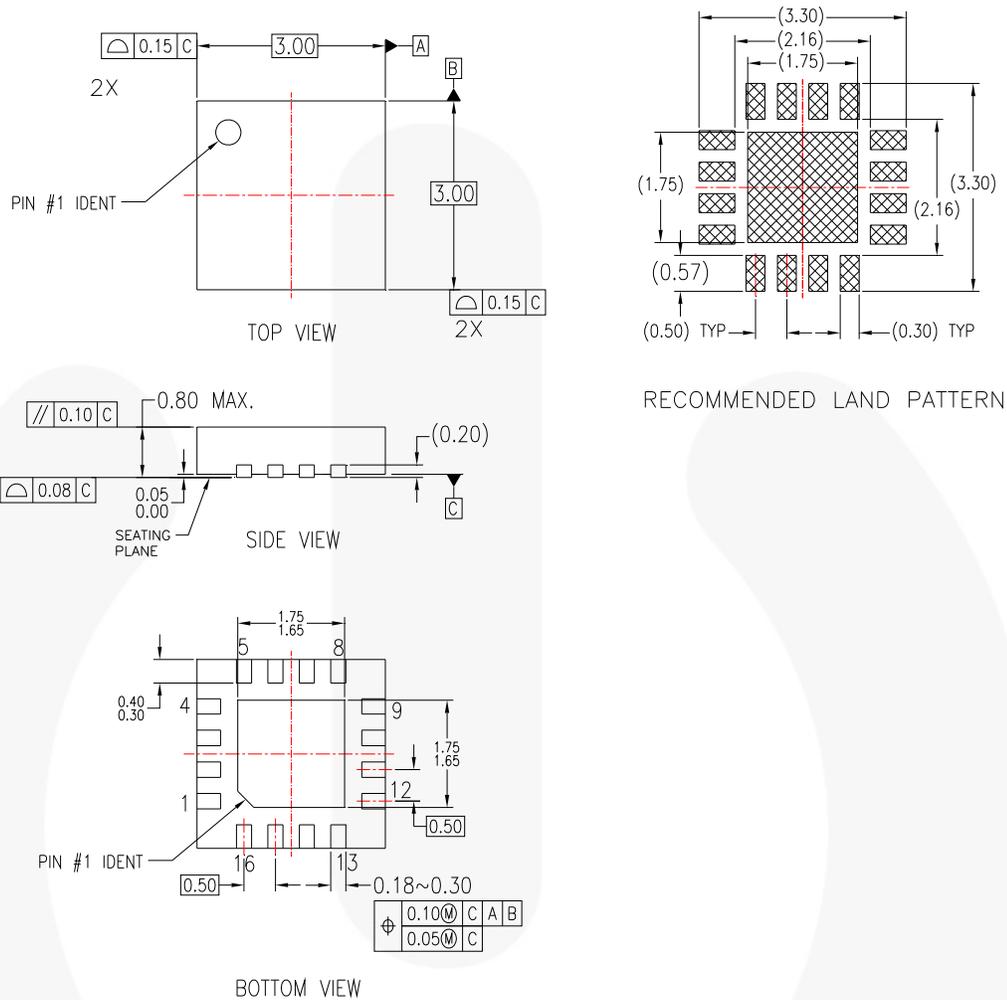
Figure 12. Clock Stop

When the clock is stopped (from time t_e to time t_f), CLK shall be maintained either at state H or at state L, according to the clock stop indicator X defined in section 8.3 of the ISO7816-3 specification.

At time t_f , the interface device restarts the clock and the information exchange on I/O may continue after at least 700 clock cycles (at time $t_f + t_h$).

The FXLP4555 supports the above description of Clock Stop per ISO7816-3 specifications.

Physical Dimensions



NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-220, VARIATION WEED—Pending, DATED pending
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994
- D. DIMENSIONS ARE EXCLUSIVE OF BURS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

MLP16BrevB

Figure 13. 16-Lead, Molded Leadless Package (MLP), QUAD, JEDEC MO-220, 3mm Square

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

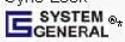
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
<http://www.fairchildsemi.com/packaging/MLP16B.html>

For current tape and reel specifications, visit Fairchild Semiconductor's online packaging area:
http://www.fairchildsemi.com/packaging/3x3MLP16_Pack_TNR.pdf



TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- | | | | |
|---|---|---|---|
| AccuPower™ | FPS™ | Power-SPM™ | The Power Franchise® |
| Auto-SPM™ | F-PFST™ | PowerTrench® | The Right Technology for Your Success™ |
| AX-CAPT™ | FRFET® | PowerXS™ | the power franchise |
| BitSiC® | Global Power Resource™ | Programmable Active Droop™ | TinyBoost™ |
| Build it Now™ | Green FPS™ | QFET® | TinyBuck™ |
| CorePLUSTM | Green FPS™ e-Series™ | QS™ | TinyCalc™ |
| CorePOWER™ | Gmax™ | Quiet Series™ | TinyLogic® |
| CROSSVOLT™ | GTO™ | RapidConfigure™ | TINYOPTO™ |
| CTL™ | IntelliMAX™ |  | TinyPower™ |
| Current Transfer Logic™ | ISOPLANAR™ | Saving our world, 1mW/W/kW at a time™ | TinyPVM™ |
| DEUXPEED® | MegaBuck™ | SignalWise™ | TinyWire™ |
| Dual Cool™ | MICROCOUPLER™ | SmartMax™ | TranSiC® |
| EcoSPARK® | MicroFET™ | SMART START™ | TriFault Detect™ |
| EfficientMax™ | MicroPak™ | SPM® | TRUECURRENT®* |
| ESBC™ | MicroPak2™ | STEALTH™ | μSerDes™ |
|  | MillerDrive™ | SuperFET® |  |
| Fairchild® | MotionMax™ | SuperSOT™.3 | UHC® |
| Fairchild Semiconductor® | Motion-SPM™ | SuperSOT™.6 | Ultra FRFET™ |
| FACT Quiet Series™ | mWSaver™ | SuperSOT™.8 | UniFET™ |
| FACT® | OptoHiT™ | SupreMOS® | V CX™ |
| FAST® | OPTOLOGIC® | SyncFET™ | VisualMax™ |
| FastvCore™ | OPTOPLANAR® | Sync-Lock™ | XS™ |
| FETBench™ |  |  | |
| FlashWriter®* | PDP SPM™ | | |

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN, NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. 154

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative