2.5A, 3MHz Switching Charger with Dynamic Power Path Management

DESCRIPTION

ETA6003 is a switching Li-Ion battery charger with dynamic power-path control and input current limiting. When a battery is connected, depending on the battery voltage, the DC-DC switching regulator either pre-conditions, fast-charges the battery or just regulates a system voltage (V_{SYS}) to a preset voltage. It does not require an external sense resistor for current sensing. The charging current is determined by programming ISET1 or ISET2 pin, depending on the state of the USB_DET. If USB_DET is low, indicating a valid AC adapter input is present, the charge current is set by ISET1; otherwise, it is set by ISET2. When the battery voltage reaches the termination voltage i.e., 4.2V, the charging path disconnects SYS to BATT. The ETA6003 also includes a dynamic power path when the SYS load current exceeds current limit of the DCDC regulator internally set, the SYS voltage falls below V_{BATT}, ETA6003 turns on the power-path to supplement the system load through the battery.

FEATURES

- Switching Charger with Power Path Management
- Up to 95% DC-DC Efficiency
- 50mΩ Power Path MOSFET
- Up to 2.5A Max charging current
- Instant on with a dead Battery or no Battery
- No battery detection
- No External Sense resistor
- Programmable USB and AC IN Charging Current
- RoHS Compliant

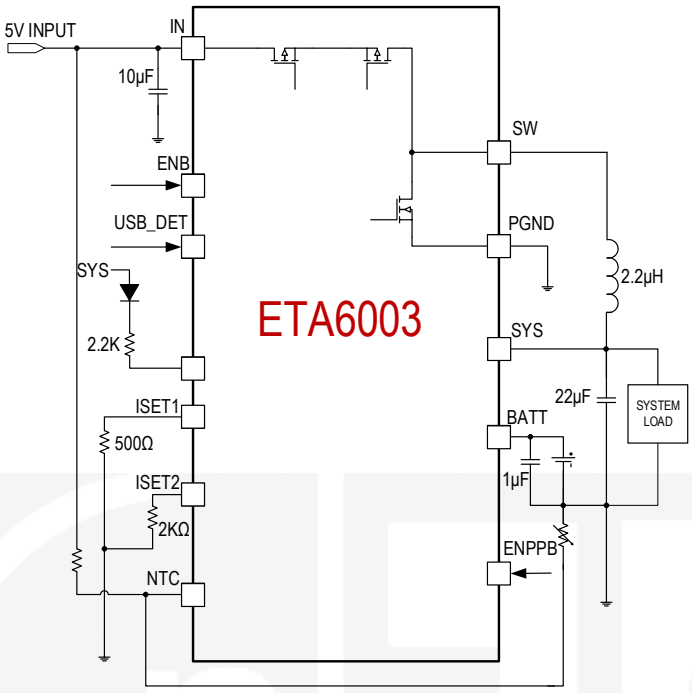
APPLICATIONS

- Tablet, MID
- Smart Phone
- Power Bank

ORDERING INFORMATION

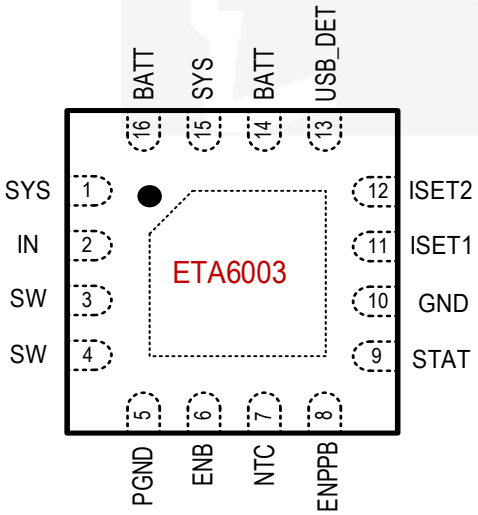
PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA6003Q3Q	QFN3X3-16	ETA6003 YWWPL	5000

TYPICAL APPLICATION



2A Switching Charger with Dynamic Power Pat

PIN CONFIGURATION



QFN3x3-16

ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

IN, BATT Voltage .....–0.3V to 6V
All Other Pin Voltage .....VIN–0.3V toVIN+0.3V
SW,SYS,BATT to ground current.....Internally limited
Operating Temperature Range .....–40°C to 85°C
Storage Temperature Range .....–55°C to 150°C
Thermal Resistance θ_{JA}
QFN3X3-16.....50 ..... °C/W

ELECTRICAL CHARACTERISTICS

(V_{IN} = 5V, unless otherwise specified. Typical values are at TA = 25°C.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
IN INPUT					
INPUT Range		4.4		5.5	V
INPUT UVLO	Rising, Hys=500mV		3.9		V
INPUT Operating Current	Switcher Enable, Switching		5		mA
	Switcher Enable, No Switching		70		μA
BATT to INPUT leakage Current	Input Floating		0	5	μA
Vhold	When VIN drop to Vhold, then reduce DC-DC current limit		4.5		V
DC-DC and SYS OUTPUT					
VSYSMIN	I_{SYS}=1A, Default		3.6		V
VSYSMAX			4.5		V
Load Regulation			40		mV/A
Line Regulation	V_{IN} =4.75 to 5.25V		0.04		%/V
Switching Frequency			3		MHz
Max duty		100			%
HIGHSIDE MOS RDSON	I_{SW} =500mA		100		mΩ
LOWSIDE MOS RDSON	I_{SW} =500mA		60		mΩ
HIGHSIDE Current limit			3.5		A
SYS UVLO	Falling, Hys=200mV		2.25		V
Thermal Shutdown	Rising, Hys=30°C		160		°C
POWER PATH Management					
BATT TO SYS RDSON			50		mΩ
BATTERY CHARGER					
Battery CV voltage	I_{BAT} =0mA, default	4.16	4.2	4.24	V
Charger Restart Threshold	From DONE to FastCharge		-150		mV
Battery Pre-condition Voltage	V_{BAT} Rising Hys=180mV		2.9		V
Pre-Condition Charge Current			100		mA
AC Fast Charge Current	R_{ISET1} =500Ω, USB_DET= low Icharge=1V*1000/R_{ISET1}		2		A
USB Charge Current	R_{ISET2} =2KΩ, USB_DET= high Icharge=1V*1000/R_{ISET2}		0.5		A
Pre-condition Timer			120		min
Fast-Charge Timer			960		min
EOC current	Percent of the fast charge current		10%		
THERMISTOR MONITOR					
NTC Threshold, Cold	Charger Suspended		76.5		%V_{IN}
NTC Threshold, Hot	Charger Suspended		35		%V_{IN}

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
NTC Threshold Hysteresis			1.5		$\%V_{IN}$
NTC Disable Threshold			100		mV
NTC Input Leakage			0		μA
LOGIC INPUT, STATS					
ENB, ENPPB Logic Input High		1.6			V
ENB, ENPPB Logic Input Low				0.3	V
STAT Output Low Voltage	I_{STATS}=10mA			0.2	V

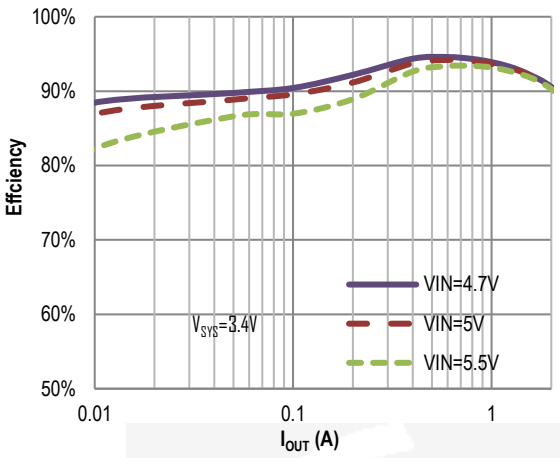
PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1,15	SYS	System Voltage Pin. It is also the Switching regulator's output pin. Connect an inductor and capacitor to form the output filter
2	IN	Input pin. Can be connected to an AC adaptor or a USB charger output. Bypass with a 10μF capacitor each to GND and PGND
3,4	SW	Switching node of the Switching Regulator. Connect a 1μH to 2.2μH inductor from this pin to SYS
5	PGND	Power Ground. Bypass with a 10μF capacitor to IN with a shortest possible trace
6	ENB	Active Low Enable pin. Tie this pin low to enable the Charging, tie high to disable Charging, while still keeping powerpath from BATT to SYS
7	NTC	Thermistor input
8	ENPPB	Shipping mode enable Pin. Tie to GND to enable power path from BATT to SYS, tie to BATT, to disable this path thereby enabling shipping mode to save power to extend battery life.
9	STATS	Status pin for Charging status indications. An open drain device capable of driving 10mA current
10	GND	Analog Ground Pin. Bypass with a 10μF capacitor to IN
11	ISET1	AC Fast Charge Current set pin for AC input. Connecting a Resistor between ISET1 to GND This sets the fast charge current value for AC adapter when USB_DET is low.
12	ISET2	USB Charge Current set pin for USB input. Connecting a Resistor between ISET2 to GND This sets the charge current value for USB input when USB_DET is high.
13	USB_DET	Charge current selecting input. Pull this pin low if an AC adapter is connected and select fast charging current to be set by ISET1. And set this pin high if a USB input is connected and select USB charging current to be set by ISET2. It is default low.
14,16	BATT	Battery pin. Connect a Battery to this pin

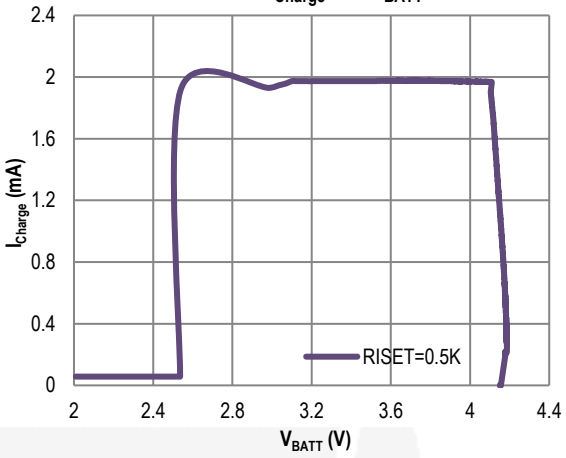
TYPICAL CHARACTERISTICS

(Typical values are at T_A = 25°C unless otherwise specified.)

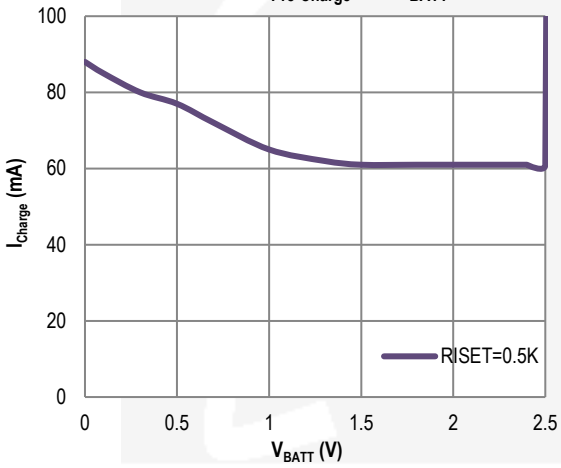
Efficiency Vs I_{SYS} Charger Disabled



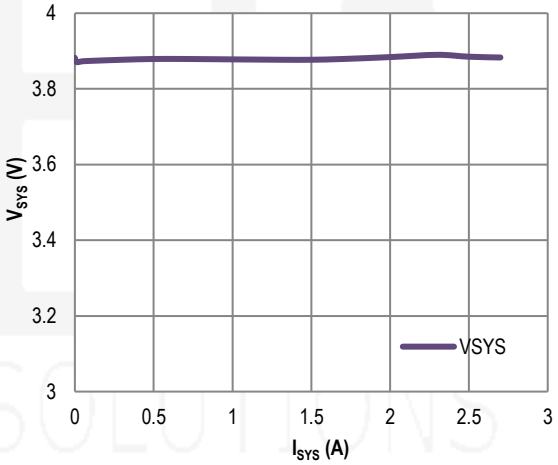
I_{Charge} Vs V_{BATT}



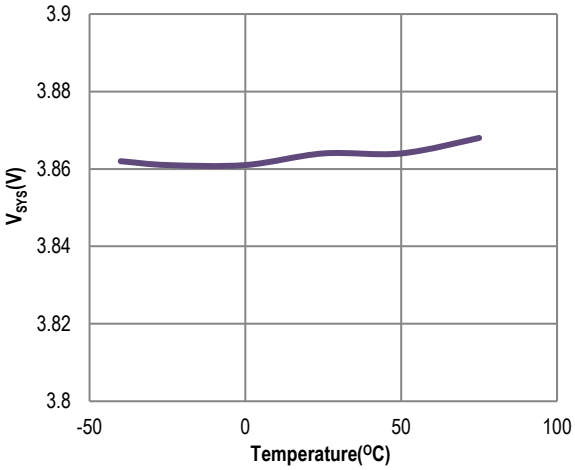
$I_{Pre\text{-}Charge}$ Vs V_{BATT}



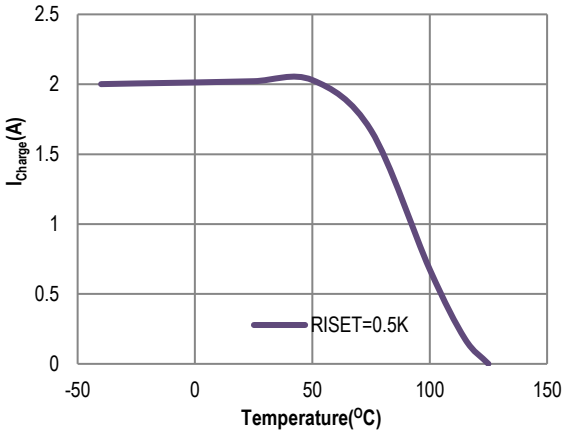
V_{SYS} Vs I_{SYS}



V_{SYS} Vs Temperature



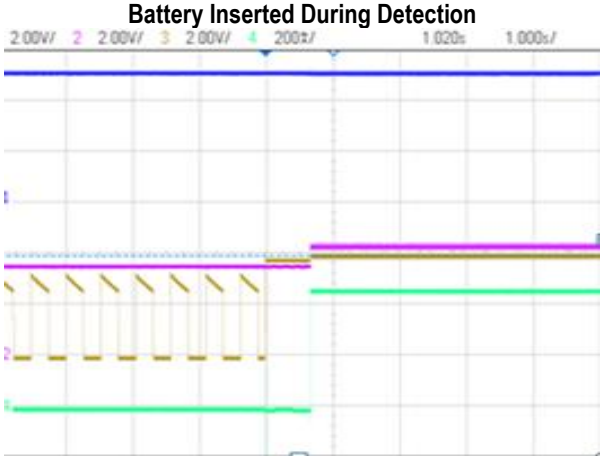
I_{Charge} Vs Temperature
Thermal Foldback



TYPICAL CHARACTERISTICS cont'd

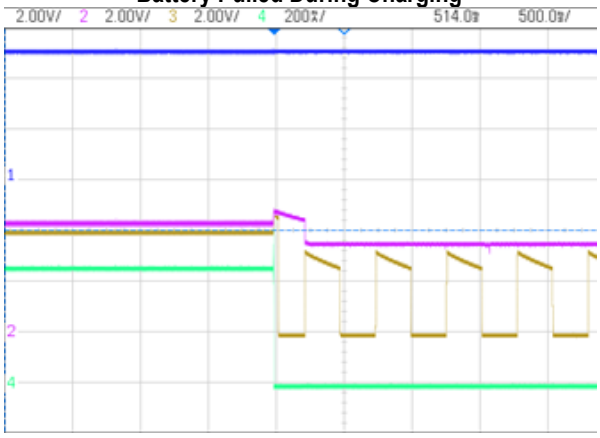
(Typical values are at T_A = 25°C unless otherwise specified.)

Battery Inserted During Detection



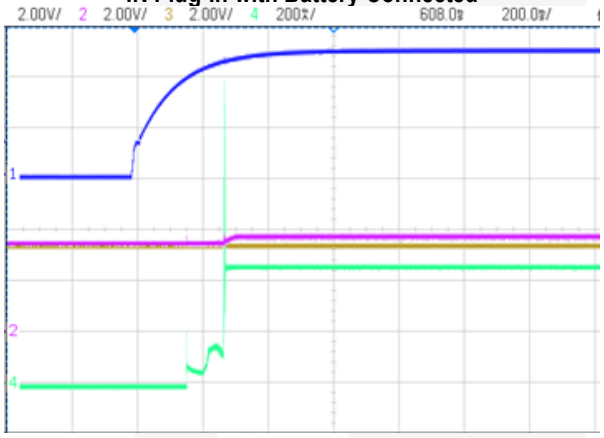
1s/div

Battery Pulled During Charging



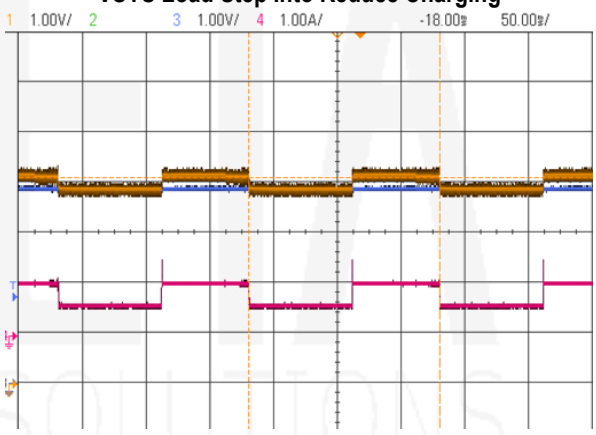
0.5s/div

IN Plug-In with Battery Connected



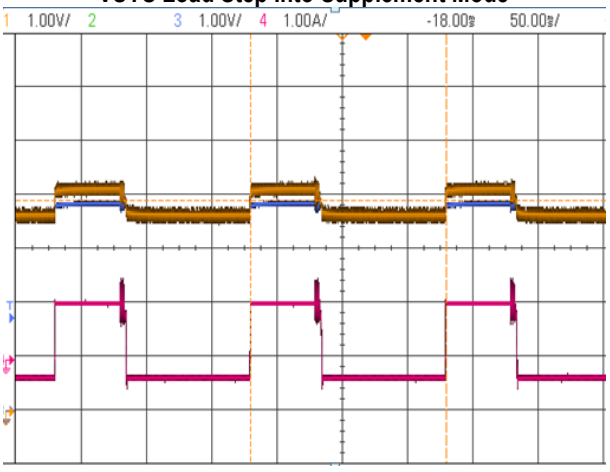
5ms/div

VSYS Load Step Into Reduce Charging



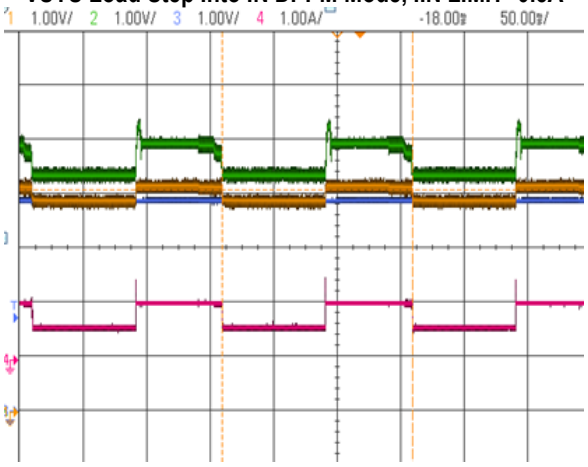
50ms/div

VSYS Load Step Into Supplement Mode



50ms/div

VSYS Load Step Into IN DPPM Mode, IIN LIMIT=0.5A

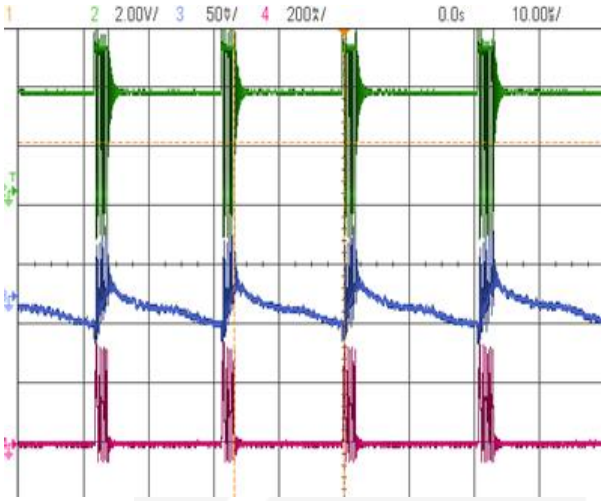


50ms/div

TYPICAL CHARACTERISTICS cont'd

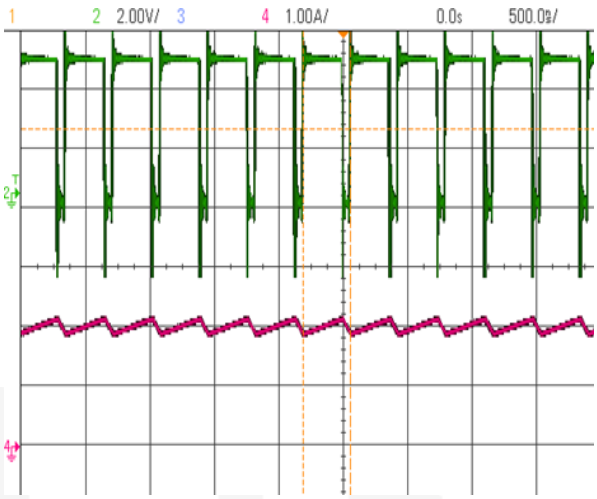
(Typical values are at T_A = 25°C unless otherwise specified.)

DCDC PFM SWITCHING WAVEFROM
I_{SYS}=10mA



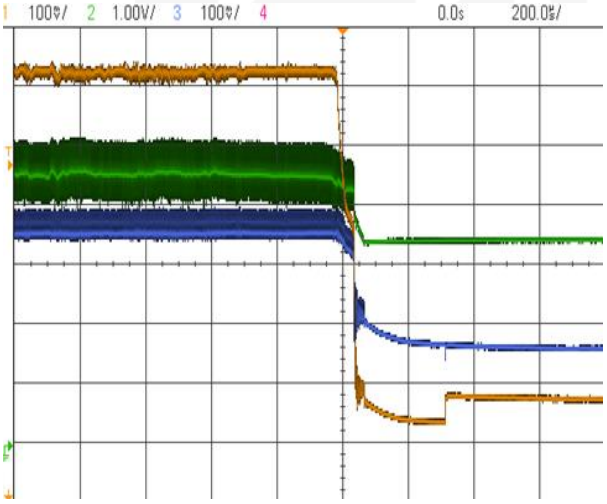
10ms/div

DCDC PWM SWITCHING WAVEFORM
ISYS=2A



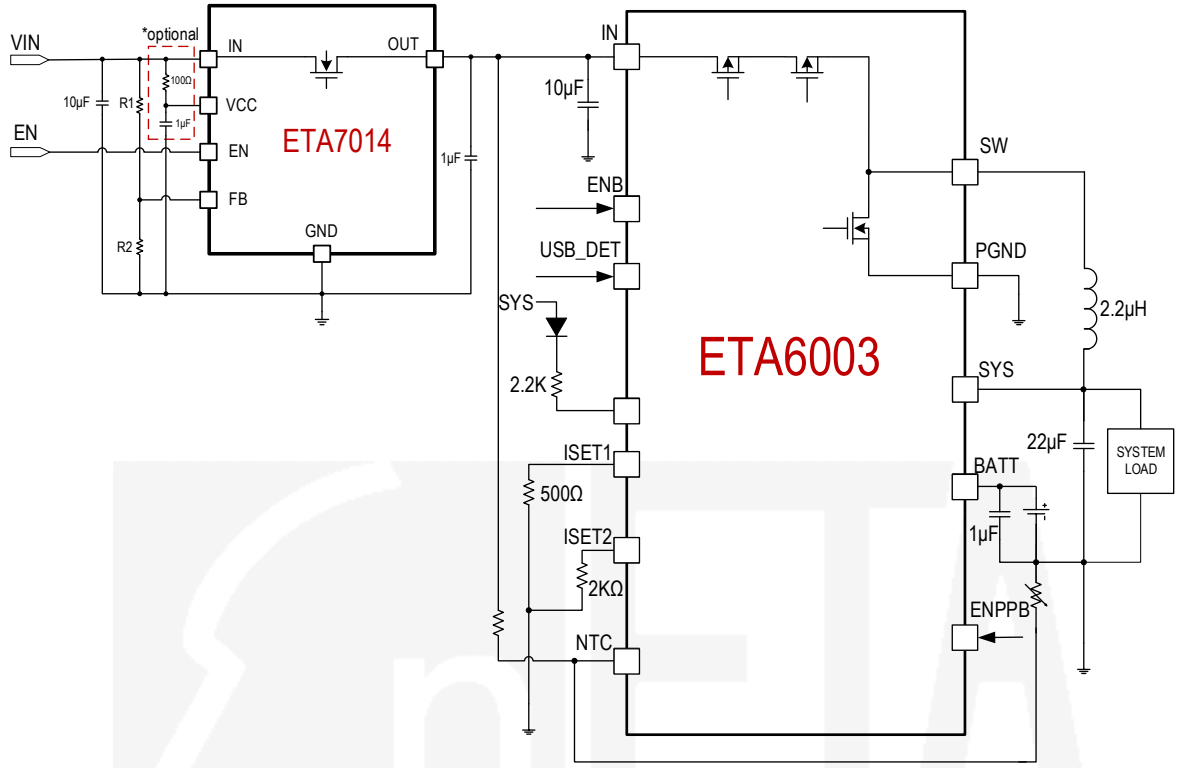
0.5us/div

IN UNPLUGGED



200us/div

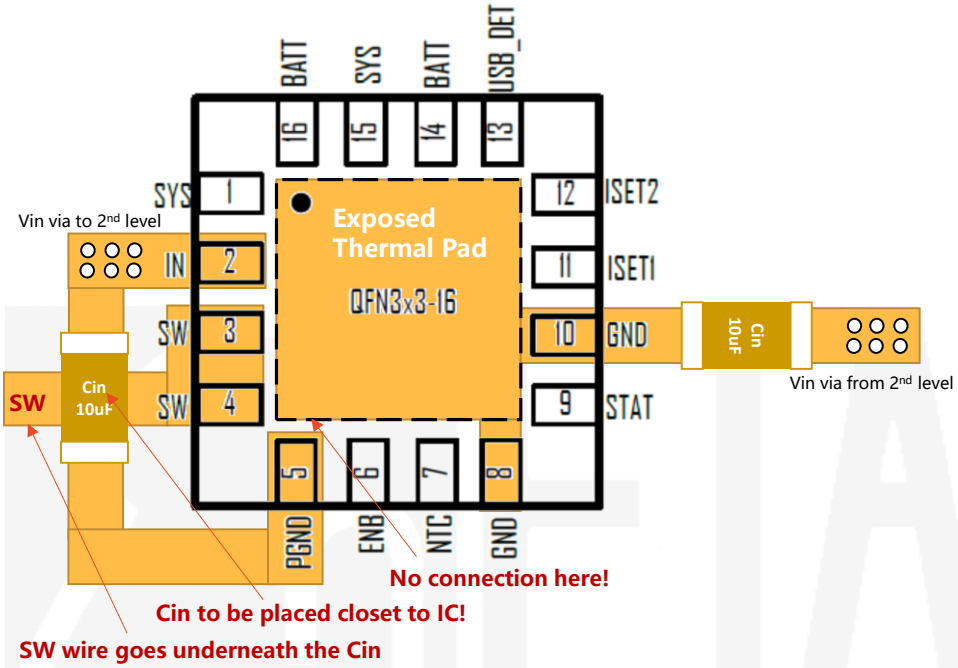
TYPICAL APPLICATION CIRCUIT



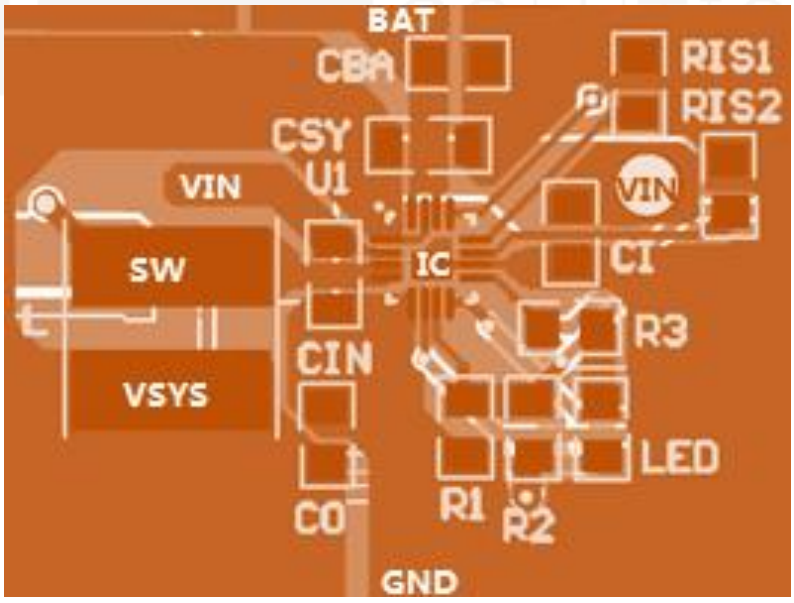
2A Switching Charger with Dynamic Power Path with OVP protection and Charge Enable

PCB GUIDELINES

PCB layout cautions of ETA6003 is shown below. The input capacitor (Cin) between Vin (Pin2) and PGND (Pin5) is always to be placed closest to the IC. SW wire can be laid through the gap between the 2 Cin terminals. It can go underneath the Cin. For all pins that needs to shorted to GND, please connect them to GND (Pin10), not to PGND (Pin5). A real PCB layout example is also listed below for reference.



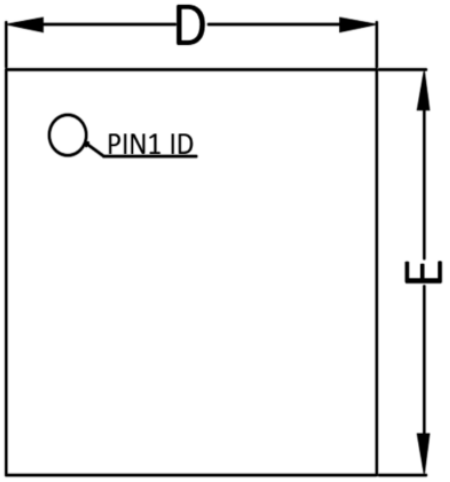
PCB cautions of ETA6003



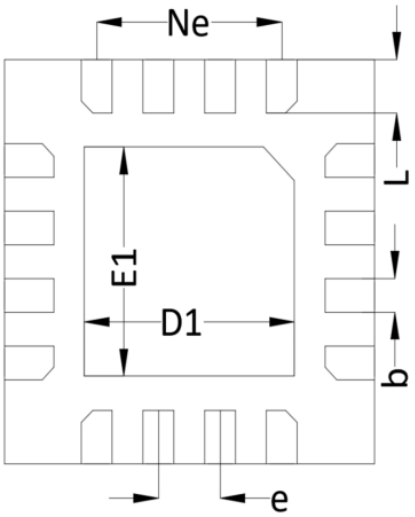
Real DEMO board PCB for reference

PACKAGE OUTLINE

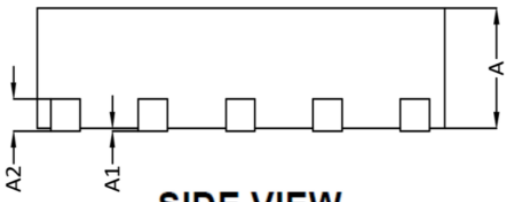
Package: QFN3x3-16



TOP VIEW



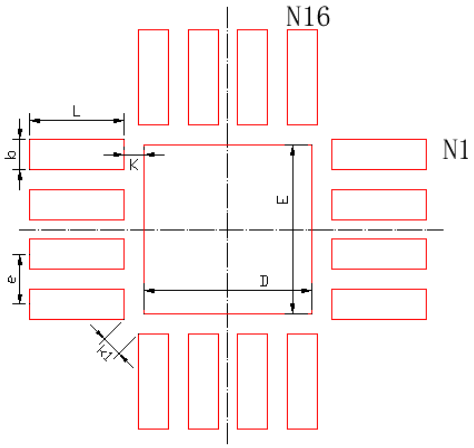
BOTTOW VIEW



SIDE VIEW

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

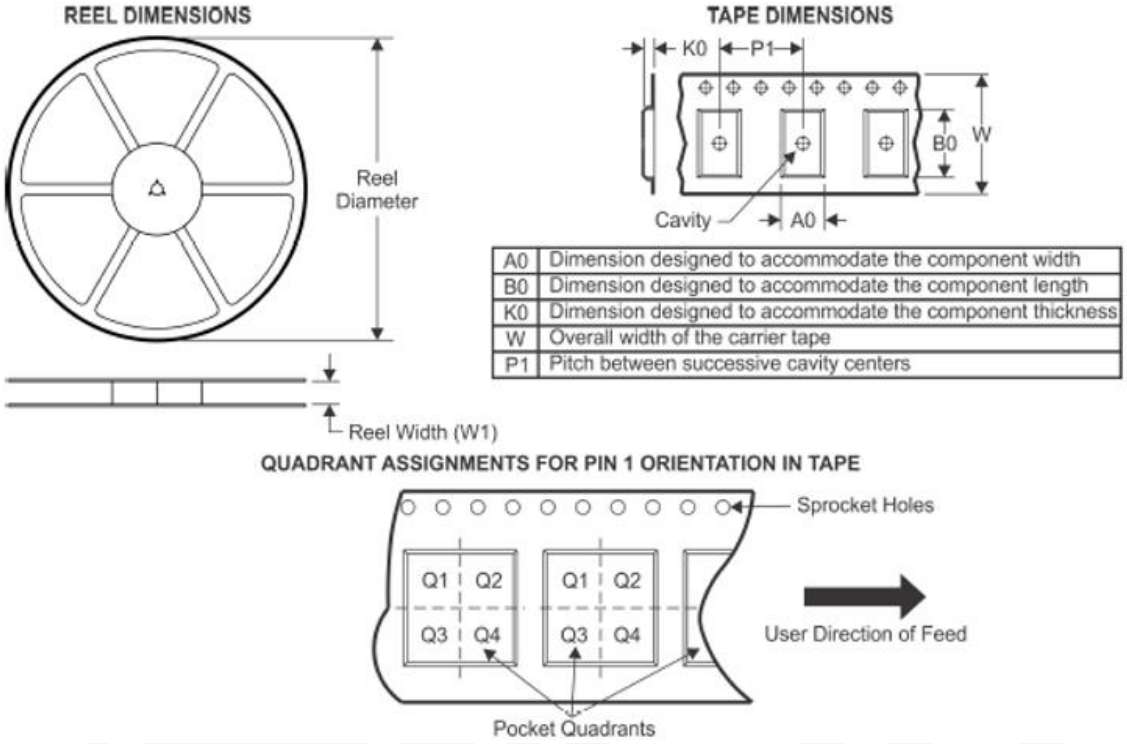
SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2		0.203 REF	
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D1	1.65	1.70	1.75
E1	1.65	1.70	1.75
Ne		1.50 BSC	
b	0.20	0.25	0.30
L	0.35	0.40	0.45
e		0.5 BSC	



RECOMMENDED LAND PATTERN

Dimensions	Value (in mm)
D	1.7
E	1.7
k	0.2
k 1	≥0.2
e	0.5
b	0.3
L	0.95

TAPE AND REEL INFORMATION



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ETA6003Q3Q	QFN3x3-16	16	5000	330	12.4	3.35	3.35	1.13	8	12	Q1