NH1-GEN1A-A

Power Solution for a Mobile Phone from a one / two cell AA Battery (Alkaline/ Rechargeable)

Features

- **Designed to power a mobile phone from a one or two cell standard-sized AA battery** (Alkaline or Rechargeable NiMH)
- Eliminates the need for costly Li-Ion battery, charging circuit and protection circuit inside the mobile phone
- Eliminates the need for costly wall charger and charging connector for the mobile phone
- Very high conversion efficiency (up-to 92%) enables up-to **4 hours of talk-time** from a single AA Alkaline battery
- Very low standby current consumptions enables up-to **275 hours of standby time** from a single AA Alkaline battery
- Glue-less interface to phone's battery contacts
- Automatic startup from 1.1 V (one cell) / 2.2 V (two cells) input voltage
- Automatic shutdown when input cell is depleted
- Optimized for low power consuming mobile phones

Description

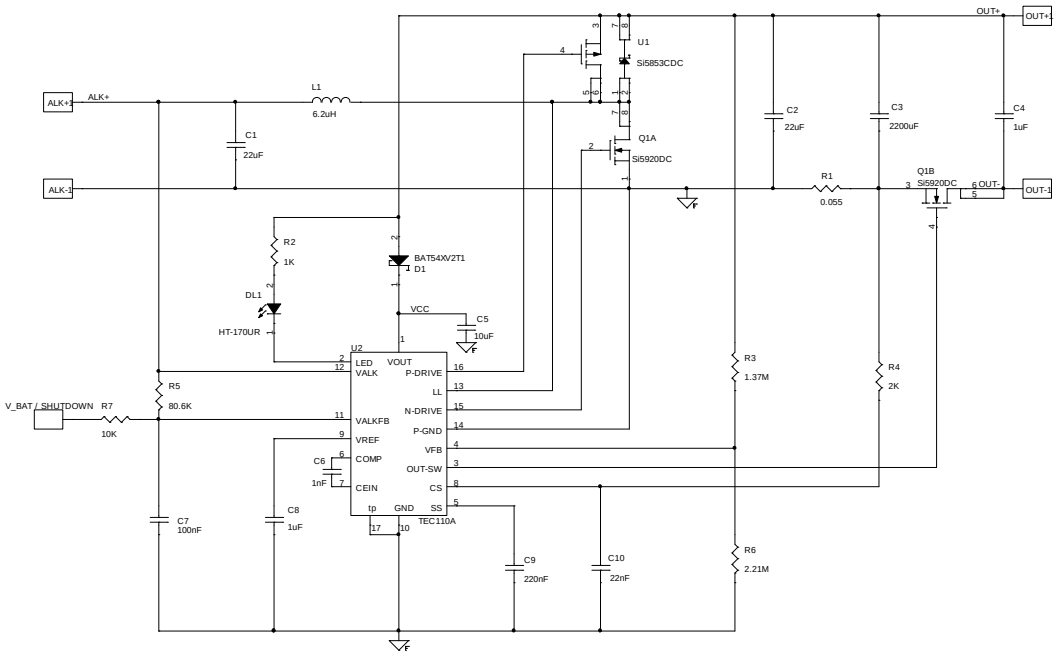
NH1-GEN1-A is Techtium's unique design of a synchronous boost converter that powers a mobile phone from a one or two cell standard size Alkaline / rechargeable AA battery.

The circuit automatically starts up once inserting a fresh AA battery (one or two cells depending on the application) and shuts-down automatically when the AA battery is depleted.

This application was designed to supply high current pulses during GSM standard transmission.

The circuit is designed to connect directly to existing phone's battery contacts, enabling the use of existing mobile phone platforms for easy integration and fast TTM.

One cell application



Absolute Maximum Ratings

Maximum input battery voltage (V_{ALK+} - V_{ALK-})..... 3.8 V
Maximum output voltage (V_{OUT+} - V_{OUT-}) ..... 4.3 V
Ambient temperature range.....-10 °C – 60 °C

Specifications

Parameter	Test Conditions	Limits			Units
		Min	Typ	Max	
Open-Circuit Voltage	V_{alk} = 1.5 V (one cell application)	4.0		4.3	V
Switching Frequency	V_{out} < 4.3 V	225	250	275	kHz
Input Off Current	V_{alk} = 0 V – 1.6 V (one cell application)			20	µA
Input Standby Current (Burst Control Mode)	V_{alk} = 1.5 V (one cell application)		65		µA
Input Standby Current (while connected to phone 2 mA output standby current)	V_{alk} = 1.5 V (one cell application)		9		mA
Input Standby Current (2.8 mA output standby current)	V_{alk} = 1.5 V (one cell application)		12		mA
Ripple at Output	V_{alk} = 1.5 V At full load (2.2 A pulses) (one cell application)		55		mV_{p-p}

Operating Procedure

External Connections

	Connects to…
ALK+	Positive terminal of the input battery
ALK-	Negative terminal of the input battery
OUT+	Output to the device's positive node
OUT-	Output to the device's negative node

Caution: *The positive and negative terminals of the battery must be connected correctly. Connecting the battery in reverse may damage the circuit.*

Caution: *ALK- and OUT- must NOT be connected to one another. Shorting ALK- to OUT- will disable operation of the circuit and may damage it.*

General Overview

Techtium's NH1-GEN1-A circuit powers a mobile phone from a one or two cell standard-sized AA battery (Alkaline or rechargeable NiMH). This application is intended for low power consuming mobile phones that are used in areas where there is no electricity infrastructure.

NH1-GEN1-A introduces major cost savings. It eliminates the need for costly Li-Ion battery, charging circuit and protection circuit inside the mobile phone. It also eliminates the need for a wall charger and charging connector.

Input Battery

NH1-GEN1-A is intended for use with a one or two cell standard primary or rechargeable (Alkaline/rechargeable NiMH) battery. It can be used with a battery of any standard size, but it is recommended to use AA batteries due to their higher capacity. Higher quality or premium batteries are recommended, as their lower internal resistance increases performance of the circuit, thus enabling a longer talk-time.

The circuit starts up when an input battery (> 1.1 V - one cell, > 2.2 V – two cells) is connected to it.

The circuit shuts down when the input battery's voltage drops below 0.9 V (per cell).

It is recommended that the host controller will shut-down the circuit when the phone is in standby mode and the input battery's voltage drops below 1 V (one cell) / 2 V (two cells).

To avoid recurring startups from a depleted battery, the NH1-GEN1-A disables startup from an input battery that has been fully depleted by the circuit, until the input battery is replaced.

Output

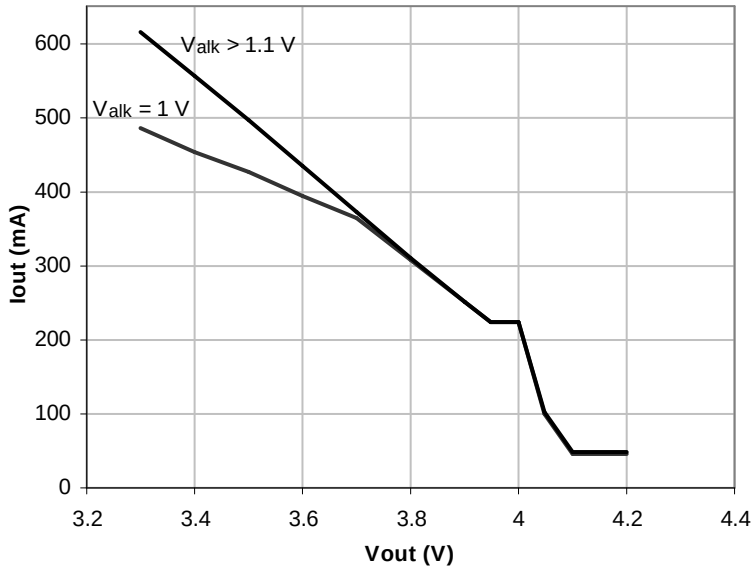
NH1-GEN1-A is intended for use with mobile phones that have relatively low power consumption.

Since each device model has different charging characteristics, it is possible that the circuit will function differently with some models. Such situations can be rectified by slight changes to the circuit. Please consult Techtium in such cases.

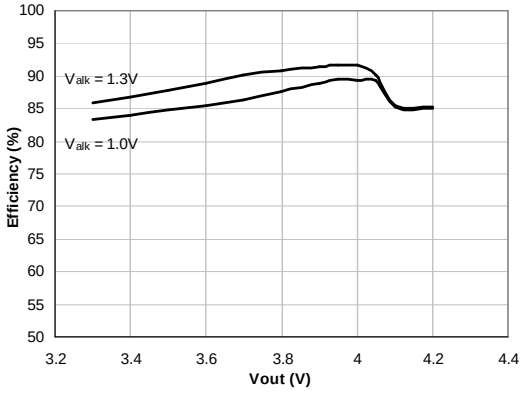
Typical Performance Characteristics

The following graphs were obtained using NH1-GEN1-A (one cell application).

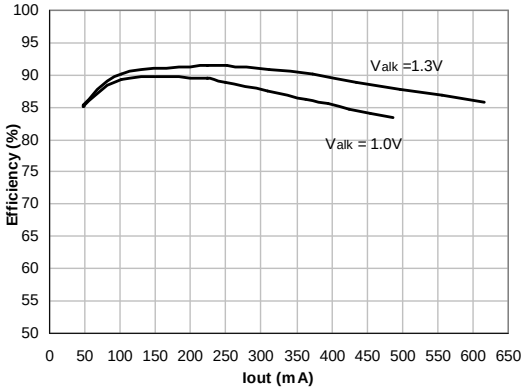
Output Current vs. Output Voltage



Efficiency vs. Output Voltage



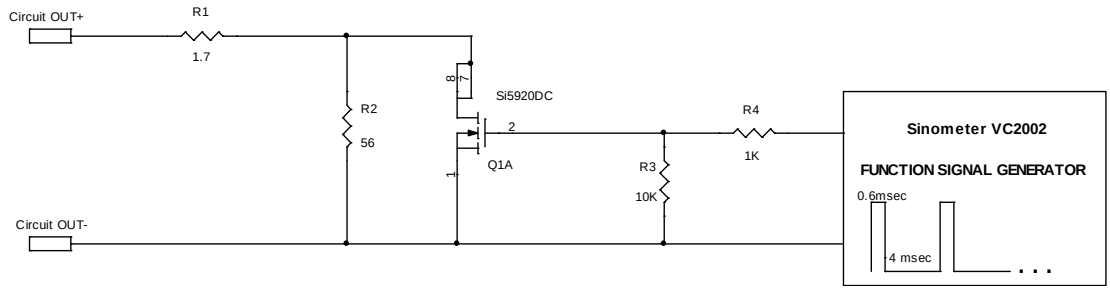
Efficiency vs. Output Current



Test results

Tests with full load at output:

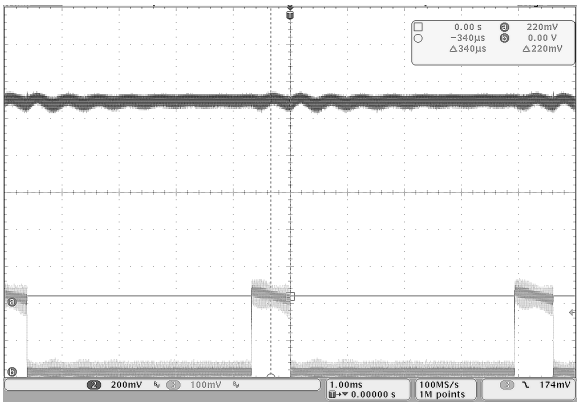
In order to test the circuit with controlled output load, the following circuit was used:



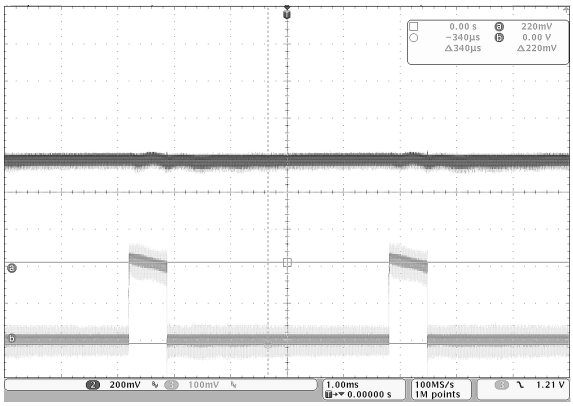
Note: All tests were performed using the one cell application.

During full load at output (2.2 A pulses) the following scope outputs were obtained:

Input voltage is 1.5 V:



Input voltage is 1 V:

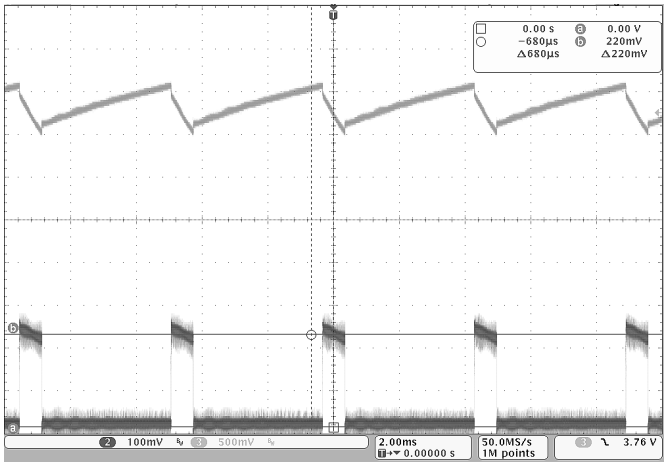


Time Base –1 ms

Voltage Base –200 mV (Vin – upper)

100 mV (Iload - lower)

Input voltage is 1.5 V:



Time Base –2 ms

Voltage Base –500 mV (Vout – upper)

100 mV (Iload - lower)

Tests with a one cell AA Alkaline / NiMH battery:

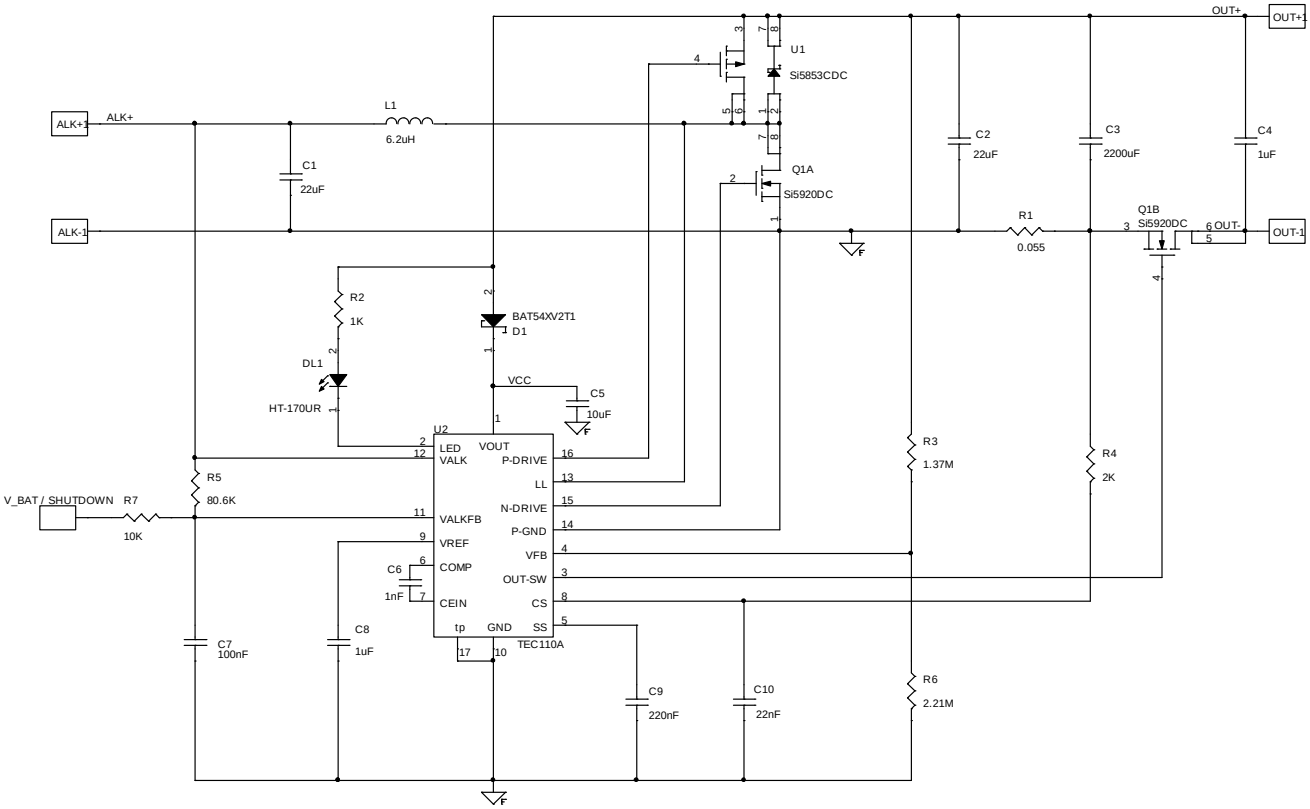
The circuit was tested with AA Alkaline and NiMH batteries.
The results are shown in the table below:

AA Battery Type	Test Conditions	Time
Alkaline (EN91)	Full load at output [1]	Max. Talk Time - 53 min
Alkaline (EN91)	Average load at output [2]	Avg. Talk Time - 4 hours
Alkaline (EN91)	Standby [3]	275 hours
NiMH (NH15)	Full load at output [1]	Max. Talk time - 109 min
NiMH (NH15)	Average load at output [2]	Avg. Talk Time – 5 hours & 50 min
NiMH (NH15)	Standby [3]	275 hours

[1] 2.2 A pulse at output using the load simulation circuit shown above.
[2] Nokia 1200 mobile phone connected at output during transmission (phone call).
[3] Mobile phone is connected at output during standby.

One cell application

Schematic:



Notes:

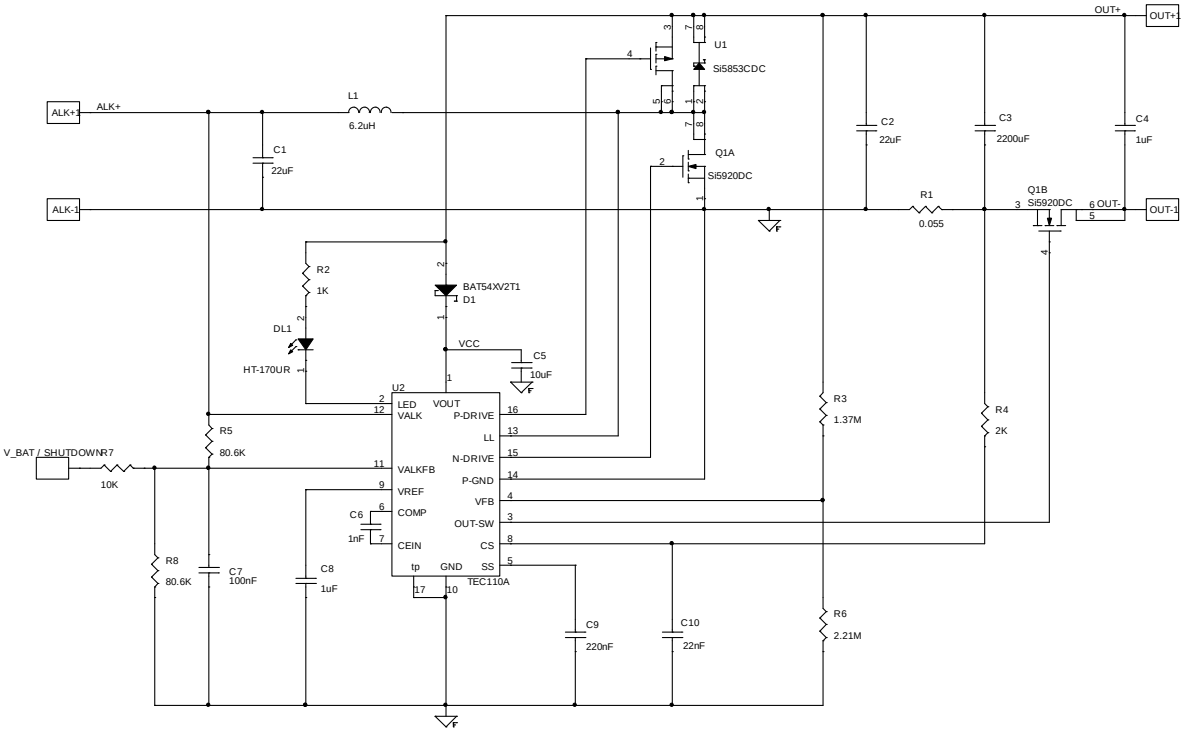
1. LED (DL1) is optional. If the LED is not desired, both DL1 and R2 should not be connected.
2. In order to sample V_{bat}, ALK+ and ALK- nodes should be connected.
3. In order to turn off the chip, pull down the ALK+ node to 0 V (using R7=10 KΩ series resistor).
4. Some phones need an additional resistor to simulate the thermal resistor located in the Li-Ion battery (between the Li-Ion ground pin to the additional pin in the phone).

Component List:

Reference	Qty	Description	Package	Part Number	Vendor
Ceramic Capacitors					
C1,C2	2	22uF, 10V, X5R, 20%	0805	LMK212BJ226MG-T	Taiyo-Yuden
C3	1	2200uF, 6.3V, Al., ESR <90mohm	10x20x0_5	EKZM6R3ELL222MJ20S	Nippon Chemi Con
C4, C8	2	1uF, 10V, X5R, 20%	0402	LMK105BJ105MV-F	Taiyo-Yuden
C5	1	10uF, 10V, X5R, 20%	0805	LMK212BJ106MG-T	Taiyo-Yuden
C6	1	1nF, 10V, X5R, 20%	0402		
C7	1	100nF, 10V, X5R, 20%	0402	LMK105BJ104MV-F	Taiyo-Yuden
C9	1	220nF, 10V, X5R, 20%	0402	LMK105BJ154MV-T	Taiyo-Yuden
C10	1	22nF, 10V, X5R, 20%	0805		
Diodes					
D1	1	Small Signal Schottky Diode	SOD523	BAT54XV2T1	On
DL1	1	SMD Red LED	0805	HT-170UR	Harvatek
Inductor					
L1	1	INDUCTOR 6.2 µH , 27 mOhm	SH6038	SH60386R2YLB	ABC Electronics
Resistors					
R1	1	0.055 Ω, 1%	0805	WSL0805 0.055 1% RT1	Vishay
R2	1	1 KΩ, 1%	0402		
R3	1	1.37 MΩ, 1%	0402		
R4	1	2 KΩ,1%	0402		
R5	1	80.6 KΩ, 1%	0402		
R6	1	2.21 MΩ,1%	0402		
R7	1	10 KΩ,1%	0402		
Transistors					
Q1	1	Dual N-Channel 1.5-V (G-S) MOSFET	1206-8	Si5920DC-T1-E3	Vishay
Integrated Circuits					
U1	1	P-Channel 20-V (D-S) MOSFET with Schottky Diode	1206-8	Si5853CDC-TI-E3	Vishay
U2	1	External Charger Controller	QFN-4x4-16	TEC110ARSAG	Techtium

Two cell application

Schematic:



Notes:

1. LED (DL1) is optional. If the LED is not desired, both DL1 and R2 should not be connected.
2. In order to sample V_{bat}, ALK+ and ALK- nodes should be connected.
3. In order to turn off the chip, pull down the ALK+ node to 0 V (using R7=10 KΩ series resistor).
4. Some phones need an additional resistor to simulate the thermal resistor located in the Li-Ion battery (between the Li-Ion ground pin to the additional pin in the phone).
5. The only difference between the one cell application and the two cell application is the addition of R8.
6. With the two cell application, the load current pulses can be higher than the 2.2 A.

Component List:

Reference	Qty	Description	Package	Part Number	Vendor
Ceramic Capacitors					
C1,C2	2	22uF, 10V, X5R, 20%	0805	LMK212BJ226MG-T	Taiyo-Yuden
C3	1	2200uF, 6.3V, Al., ESR <90mohm	10x20x0_5	EKZM6R3ELL222MJ20S	Nippon Chemi Con
C4, C8	2	1uF, 10V, X5R, 20%	0402	LMK105BJ105MV-F	Taiyo-Yuden
C5	1	10uF, 10V, X5R, 20%	0805	LMK212BJ106MG-T	Taiyo-Yuden
C6	1	1nF, 10V, X5R, 20%	0402		
C7	1	100nF, 10V, X5R, 20%	0402	LMK105BJ104MV-F	Taiyo-Yuden
C9	1	220nF, 10V, X5R, 20%	0402	LMK105BJ154MV-T	Taiyo-Yuden
C10	1	22nF, 10V, X5R, 20%	0805		
Diodes					
D1	1	Small Signal Schottky Diode	SOD523	BAT54XV2T1	On
DL1	1	SMD Red LED	0805	HT-170UR	Harvatek
Inductor					
L1	1	INDUCTOR 6.2 µH , 27 mOhm	SH6038	SH60386R2YLB	ABC Electronics
Resistors					
R1	1	0.055 Ω, 1%	0805	WSL0805 0.055 1% RT1	Vishay
R2	1	1 KΩ, 1%	0402		
R3	1	1.37 MΩ, 1%	0402		
R4	1	2 KΩ,1%	0402		
R5, R8	2	80.6 KΩ, 1%	0402		
R6	1	2.21 MΩ,1%	0402		
R7	1	10 KΩ,1%	0402		
Transistors					
Q1	1	Dual N-Channel 1.5-V (G-S) MOSFET	1206-8	Si5920DC-T1-E3	Vishay
Integrated Circuits					
U1	1	P-Channel 20-V (D-S) MOSFET with Schottky Diode	1206-8	Si5853CDC-TI-E3	Vishay
U2	1	External Charger Controller	QFN-4x4-16	TEC110ARSAG	Techtium

Notes

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