Photoflash Capacitor Charger for DSC

Feature

- **VCC 2.9V to 5.5V Supply Voltage Operating Range.**
- **Suitable voltage range for Battery 1.6V to 9V.**
- **Adjustable Output Voltage.**
- **Adjustable Peak Current.**
- **Charge Complete Indicator.**
- **Built-in IGBT Driver.**
- **Thermal Protection**
- **Built-in Output Short Circuit Protection**
- **Charges Any Size Photoflash Capacitor.**
- **Small 10-lead DFN Package.**

Application

- **Digital / Film Camera Flash**
- **PDA / Cell Phone Flash.**

Description

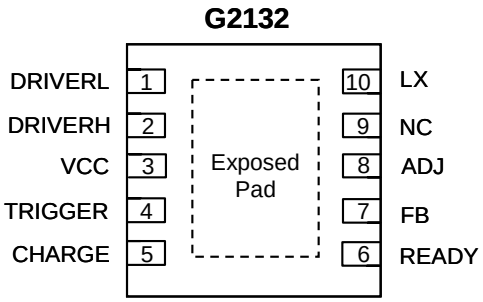
The G2132 is a charger IC for Photoflash capacitor with soft-start function, an IGBT driver for igniting flash tube, adjustable output voltage and adjustable primary peak current to perform energy transition on each charge cycle. The output voltage is determined by voltage divider connecting to the anode of the rectifying diode. The voltage sensing path is cut off when charging function to be completed to maintain minimum output voltage decay. It also provides SCP function for the voltage divider open or output short.

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G2132K21U	2132	-40°C to +85°C	TDFN2X2-10

Note: K2: TDFN2x2-10
1: Bonding Code
U: Tape & Reel
Green : Lead Free / Halogen Free

Pin Configuration



TDFN2X2-10

Note: Exposed Pad must connect to GND.

Absolute Maximum Ratings

VCC, TRIGGER, DRIVERH, DRIVERL, CHARGE, ADJ, FB and READY Voltage. . . . . -0.3V to +6V
LX Voltage. . . . . .+55V
Power Supply Voltage (VCC) . . . . . .-0.3V to 5.5V
Thermal Resistance Junction to Ambient, (θ_{JA})
TDFN2X2-10 . . . . . .201°C/W
Continuous Power Dissipation (T_A = +25°C)
TDFN2X2-10 . . . . . .0.6W
Thermal Resistance Junction to Case, (θ_{JC})
TDFN2X2-10 . . . . . 63°C/W
Junction Temperature . . . . . 125°C
Storage Temperature Range . . . . . -40°C to 125°C
ESD Susceptibility (HBM) 2kV
ESD Susceptibility (MM) 200V
Reflow Temperature (soldering, 10sec) . . . . . 260°C

Recommended Operation Conditions

Power Supply Voltage (VCC) . . . . . .2.9V to 5.5V
Operating temperature (Top) Range. . . . . .-40 to 85°C
LX Voltage (V_{LX}) . . . . . +50V

* Please refer to Minimum Footprint PCB Layout Section.

1. Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
2. Device are ESD sensitive. Handling precaution recommended. The Human Body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Electrical Characteristics

VCC=3.3V, T_A=+25°C.

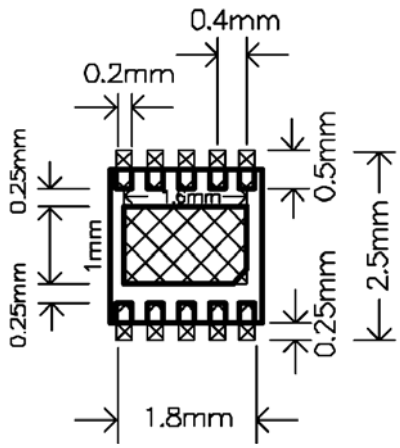
The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified.

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Input operating voltage	VCC		2.9	---	5.5	V
Input under-voltage threshold	V_{UVLO}	VCC falling	---	2.5	---	V
Feedback voltage	V_{FB}	T_A=+25°C	---	1.5	---	V
Feedback voltage tolerance	---	T_A =+25°C	-1.2	---	+1.2	%
Shutdown current	I_{OFF}	CHARGE pin=GND	---	5	10	μA
Operation Current	I_{CC1}	Switching(open loop) , FB=1.0V	---	1	2	mA
Quiescent Current	I_{CC}	No Switching , FB=1.7V	---	5	10	μA
ADJ Threshold of Peak Current	I_{PEAK1}	Rset= 20 kΩ	1.8	2	2.2	A
ADJ Threshold of Peak Current	I_{PEAK2}	Rset= 40 kΩ	0.9	1	1.1	A
Primary side Current limit (1)	$I_{LX(MAX)}$		2.8		4.0	A
LX Switch On-Resistance	$R_{LX(ON)}$	I_{LX}=1A	---	0.3	---	Ω
LX Leakage Current	I_{LC}	V_{LX}=45V, CHARGE pin=GND	---	0.01	6	μA
DriverH pull-up resistance	R_{DH}	VCC=3.3V, Trigger=H	---	4.6	---	Ω
DriverH internal pull-low resistance	R_{DHI}	VCC=3.3V, Trigger=L	---	20	---	kΩ
DriverL pull-low resistance	R_{DL}	VCC=3.3V, Trigger=L	---	4.2	---	Ω
DriverH internal pull-low resistance	R_{DLI}	VCC=3.3V, Trigger=H	---	20	---	kΩ
Trigger signal high	---		1.8	---	---	V
Trigger signal low	---		---	---	0.8	V
Trigger pin to GND	---		---	350	---	kΩ
Charge						
Input voltage high	V_{ON}		1.4	---	---	V
Input voltage low	V_{OFF}		---	---	0.6	V
Pull low resistance	---		---	1	---	MΩ
Ready						
Ready pin On Voltage	---	33μA into Ready pin	---	5	10	mV
Ready pin Leakage current when OFF	---	VReady=3.3V	---	0.01	1	μA
Thermal Shutdown (Junction Temperature)	---	Hysteresis 60°C	---	150	---	°C

Note 1: maximum primary side current in normal application may be restricted by maximum on-time of internal setting or the chosen transformer primary side inductance.

Minimum Footprint PCB Layout Section

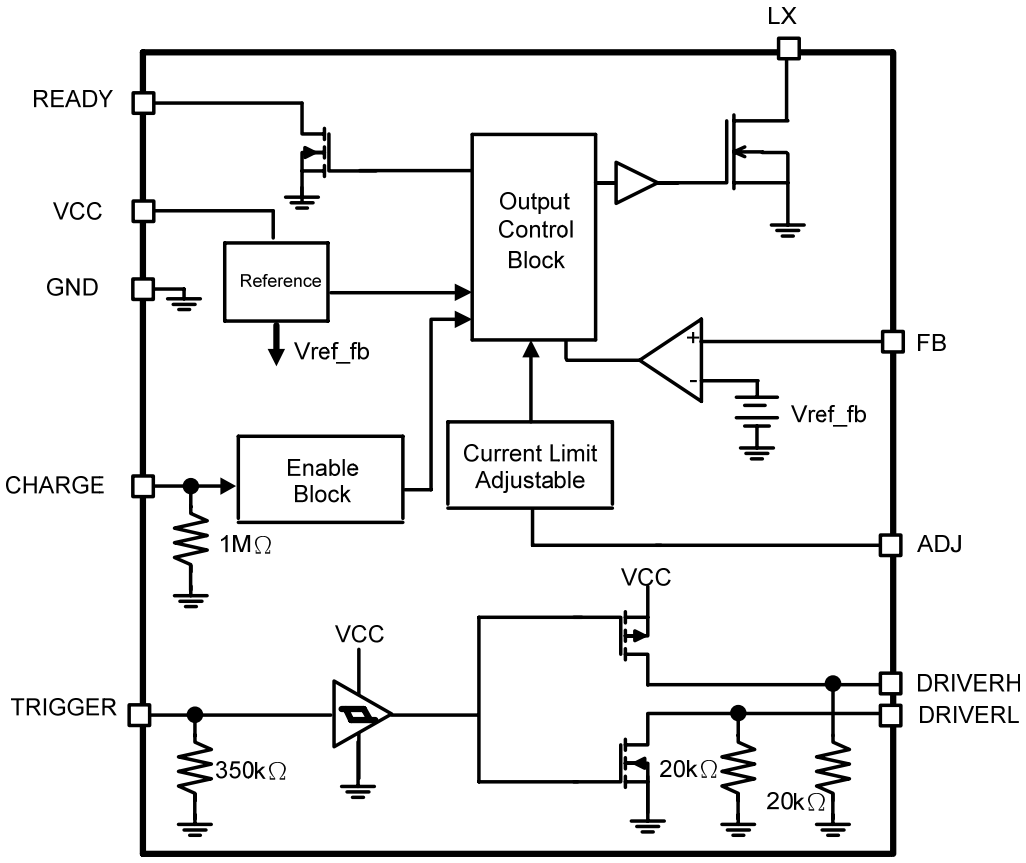
TDFN2X2-10



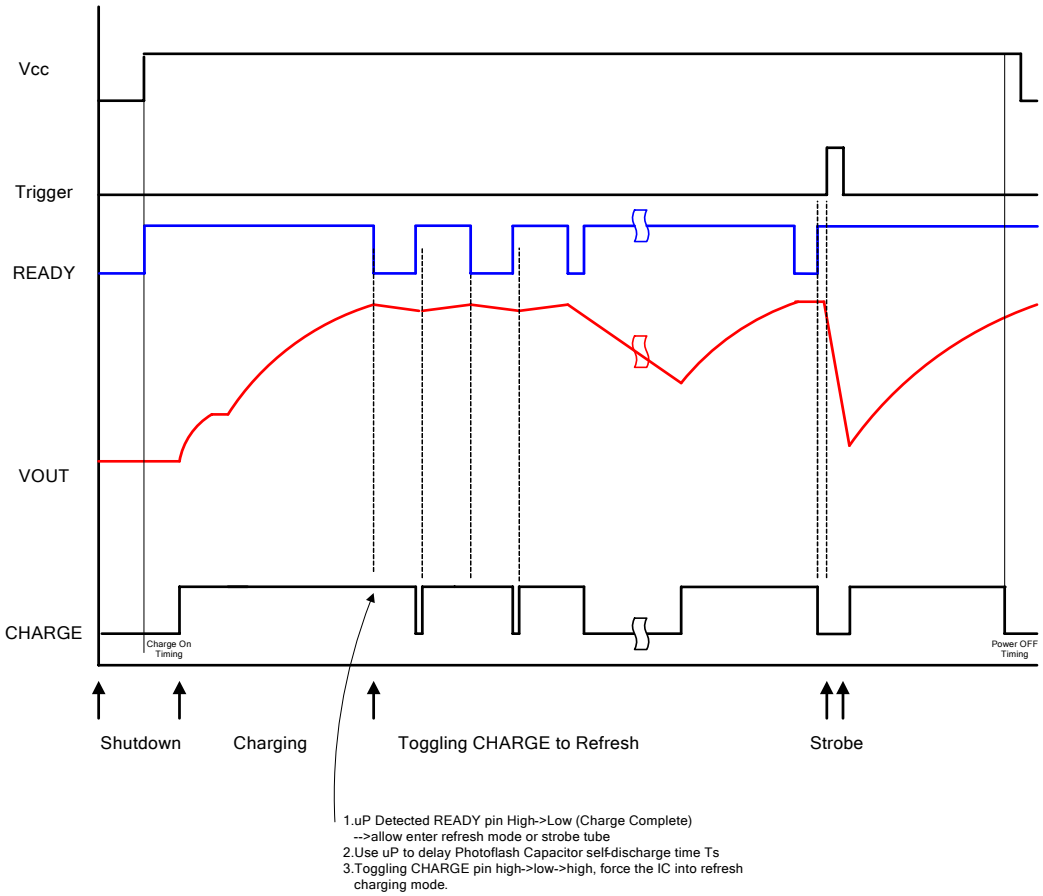
Pin Description

PIN NO	Symbol	I / O	Description
1	DRIVERL	O	IGBT Pull High Driver output.
2	DRIVERH	O	IGBT Pull Low Driver output.
3	VCC	P	Power Supply.
4	TRIGGER	I	IGBT Trigger signal input.
5	CHARGE	I	Charge enable input
6	READY	O	Charge ready open drain output.
7	FB	I	Comparator input
8	ADJ	I	Primary Peak Current Adjustable
9	NC	-	Not connected
10	LX	I	Power MOSFET N-channel Drain. Connect Primary transformer. Take care to use the correct phasing of the transformer.
EP	Exposed Pad	GND	Must connect to GND.

Block Diagram



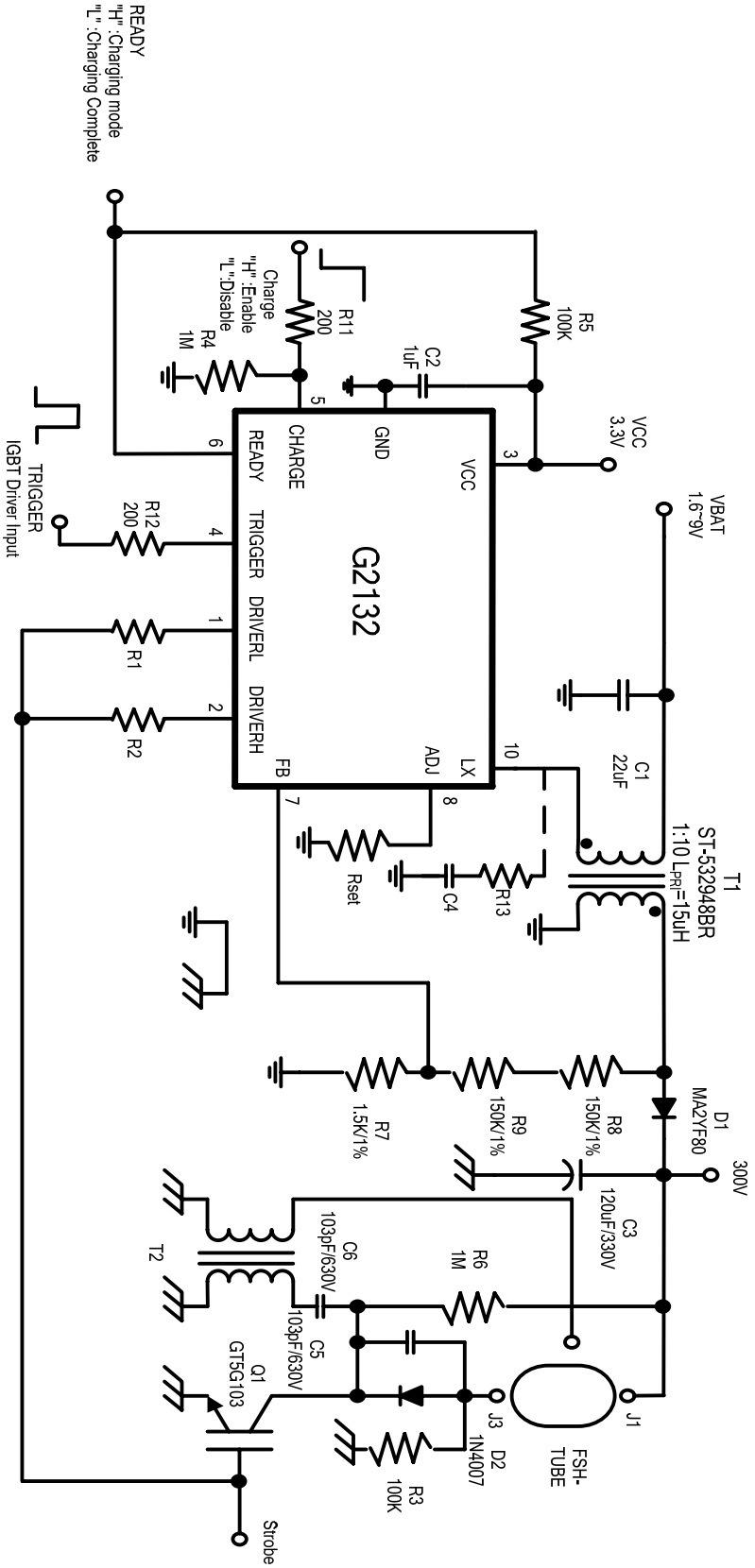
Timing Chart



G2132 Charge Toggle-Refresh (Soft-ware control) Mode

Typical Operating Characteristics

Application Circuit



Application Information

G2132 is designed to precise control of switching current to charge photoflash capacitors quickly and efficiently. When the CHARGE pin is first driven high, a one shot set SR latches in the correct state. The built-in power MOSFET turns on and primary current ramps up linearly according to V_{BAT} and primary inductance. Comparator monitors the switch current and when the switch current reaches setting value, MOSFET is turned off. During this phase, stored energy of primary transformer is delivered to the photoflash capacitor via the secondary and diode. The secondary current is decreased linearly at a rate determined by the secondary inductance. When the secondary current drops to 0mA and V_{LX} drops, the fires a one shot will turn on MOSFET. The charging cycle repeats to deliver power to the output.

G2132 can adjust external resistance R_{set} to set N-MOS switch peak current, but switch peak current must match with electrical characteristic of transformer. It is usually equal to or less than saturation current of transformer otherwise transformer will be saturated. Therefore, efficiency will be reduced.

The N-channel MOSFET is turned on and pulling the READY pin low, indicating that the part has finished charging. Power delivery can only be restarted by toggling the CHARGE pin. The CHARGE pin gives full control of the part to the user. The IGBT buffer will provide a sufficient current to drive IGBT to ignite flash tube.

Transformer Design

The Fly-back transformer is a key element for G2132. It must be designed carefully and checked that it does not cause excessive current or voltage on any pin of the part. The first transformer parameter that needs to be set is the turns ratio N, should be high enough so that the absolute maximum voltage rating for the NMOS drain to source voltage is not exceeded. Choose the minimum turns ratio according to following formula:

$$N_{MIN} \geq \frac{V_{OUT} + V_D}{V_{DS(MAX)} - V_{BAT}}$$

where

V_{OUT}: Target Output Voltage

$V_{DS(MAX)}$:Maximum drain to source voltage of NMOS.

V_D: The Forward Voltage drop of the Output Diode.

Adjustable Output Voltage

The feedback reference voltage is 1.5V. Calculate the remaining resistors with following equations:

$$V_{OUT} = V_{FB} \times (1 + \frac{R_8 + R_9}{R_7})$$

R8 and R9 must be greater than 0805 size resistor (typical 1206) for enduring secondary HV. R8 and R9 together need to have a breakdown voltage of at least 300V.

A resistor divider can be connected to the anode of the diode or the central of the dual diode to eliminate the leakage current. Choose the lower resistor R7 connected from FB to GND, between 1kΩ and 2kΩ. Larger resistor combined with parasitic capacitance at FB pin would affect the V_{OUT} detection accuracy.

Rectifying Diode

The rectifying diode should be low capacitance (short reverse recovery time) type with sufficient reverse recovery-voltage and forward current ratings. The peak reverse recovery-voltage that diode is approximately:

$V_{PK-R} \cong V_{OUT} + (N * V_{BAT})$

The peak current of the diode is simply:

$I_{PK-SEC} = I_{PK-PRI} / N$

Rating	Part Number	Manufacturer
2x250V, 225mA, 5pF	BAV23S	Fairchild
2x300V, 225mA, 5pF	GSD2004S	Vishay
2x300V, 225mA, 5pF	MMBD3004S	Diode
800V, 200mA, 2pF	MA2YF80	Panasonic

Primary Inductance

A fly-back transformer needs to store substantial amounts of energy in the core during each switching cycle. The transformer will generally require an air gap. The use of an air gap in the core makes the energy storage. While the power switch is off, energy transferred to the output capacitor is proportional to the primary inductance for a constant primary current.

The primary inductance needs to be equal or larger than a certain minimum value to ensure that G2132 has adequate time to respond to the fly-back waveform. The switch off time should be 300ns or larger for the G2132. The minimum inductance can be calculated with the following formula:

$$L_{PRI} \geq \frac{300 \times 10^{-9} \times V_{OUT}}{N \times I_{PK-PRI}}$$

where

V_{OUT}: Target Output Voltage

N: Transformer Turns Ratio

I_{PK-PRI}: Primary Peak Current

Transformer Secondary Capacitance

The total capacitance on the secondary of the transformer will severely affect the efficiency of the circuit. Any secondary capacitance is multiplied by N^2 when reflected to the primary. Since this capacitance forms a resonant circuit with the primary leakage inductance of the transformer. As such, both the primary leakage inductance and secondary side capacitance should be minimized.

Adjustable Input Current

The G2132 can adjust N-MOS switch peak current by a resistor connecting to ADJ pin. This resistor determines the primary peak current of primary N-MOS as the following equation:

$$I_{PK-PRI} = \frac{V_{ADJ} \times 26.667}{R_{set}} = \frac{40}{R_{set}}(A), R_{set} = \frac{40}{I_{PK-PRI}}(k\Omega)$$

$$T_{ON} = \frac{I_{PK-PRI} \times L_{PRI}}{V_{BAT}}$$

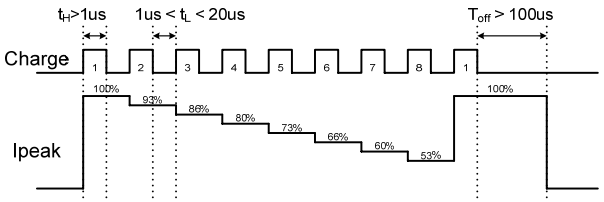
where

L_{PRI}: primary inductance (μH)

I_{PK-PRI}: peak primary current (A)

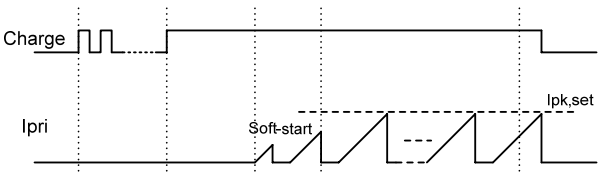
R_{set}: It is recommended several kΩ grade

The I_{PK-PRI} of G2132 can also be adjusted by clocking CHARGE pin, which is shown as followed:



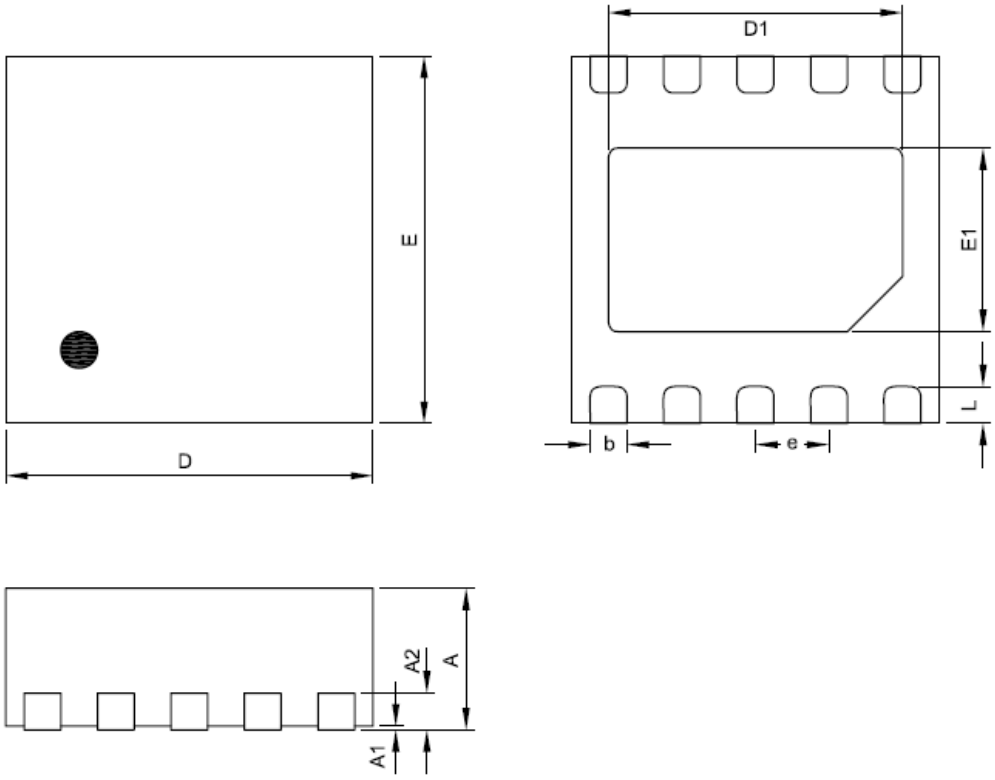
CLK	IPK
1	100%
2	93%
3	86%
4	80%
5	73%
6	66%
7	60%
8	53%

G2132 will start to charge the output after CHARGE stop clocking, which is shown as the followed figure.



Note that the function of input current adjustment may restrict applicable battery operating range.

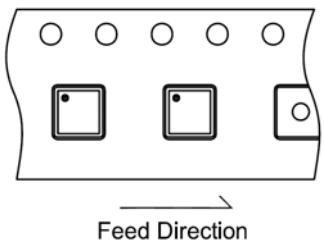
Package Information



TDFN2X2-10 Package

Symble	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.0276	0.0295	0.0315
A1	0.00	---	0.05	0.0000	---	0.0020
A2	0.19	0.20	0.21	0.0075	0.0079	0.0083
D	1.95	2.00	2.05	0.0768	0.0787	0.0807
E	1.95	2.00	2.05	0.0768	0.0787	0.0807
D1	1.55	1.60	1.65	0.0610	0.0630	0.0650
E1	0.95	1.00	1.05	0.0374	0.0394	0.0413
b	0.15	0.20	0.25	0.0059	0.0079	0.0098
e	0.40 BSC			0.0157 BSC		
L	0.20	0.25	0.30	0.0079	0.0098	0.0118

Taping Specification



PACKAGE	Q'TY/REEL
TDFN2X2-10	3,000 ea