SGM41566
Linear Regulation Battery Charger

GENERAL DESCRIPTION

The SGM41566 is designed for charging low capacity battery cell with factory-programmable current programmable in the range of 50mA to 750mA from loosen regulated power source. The device features low drop-out constant-current constant-voltage charging, weak battery pre-charging, voltage fold-back safe retaining, floating charging protection and system start-up pre-charge, with NTC sensing protection.

The SGM41566 is available in a Green TDFN-2×2-8AL package. It operates in -40℃ to +125℃ junction temperature.

FEATURES

- **Loosen Regulated Power Input**
- **Battery Voltages Option:**
  25mV Raster in 3.5V to 4.8V Range
- **Charging Current Option:**
  50mA Raster in 50mA to 750mA Range
- **5% to 25% Residual End-of-Charge Option**
- **Weak Battery Pre-Charge Option**
- **Voltage Fold-Back Safe Power Retaining**
- **NTC Temperature Sensing for Protection**
- **Floating Charging Protection**
- **Start-Up Charging for 12.5ms**
- **650ms Power Recycle Certification**
- **Full Charging Power-Up at Low Voltage**
- **Pre-Charging Power-Up at Normal Voltage**
- **Available in a Green TDFN-2×2-8AL Package**

APPLICATIONS

Low Capacity Rechargeable Battery Powered Applications

TYPICAL APPLICATION

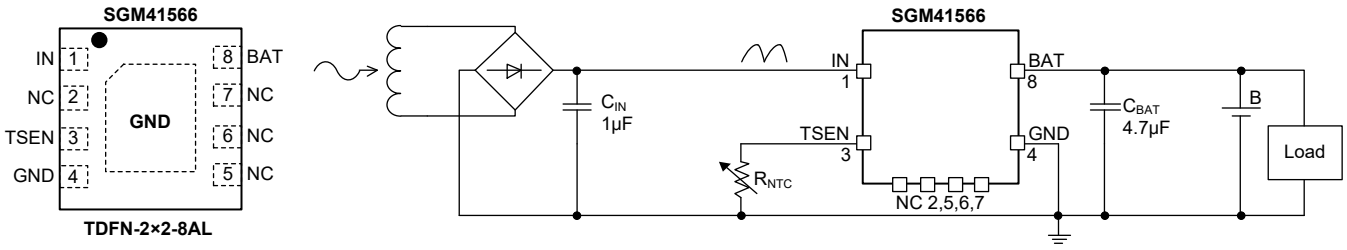


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

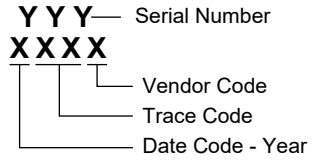
MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41566-350C55	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-350C55XTDE8G/TR	MDV XXXX	Tape and Reel, 3000
SGM41566-360F41	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-360F41XTDE8G/TR	MDR XXXX	Tape and Reel, 3000
SGM41566-360N21	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-360N21XTDE8G/TR	07B XXXX	Tape and Reel, 3000
SGM41566-365A33	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-365A33XTDE8G/TR	074 XXXX	Tape and Reel, 3000
SGM41566-365A41	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-365A41XTDE8G/TR	MDU XXXX	Tape and Reel, 3000
SGM41566-365O12	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-365O12XTDE8G/TR	MDW XXXX	Tape and Reel, 3000
SGM41566-365O22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-365O22XTDE8G/TR	MDM XXXX	Tape and Reel, 3000
SGM41566-405A14	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405A14XTDE8G/TR	MDT XXXX	Tape and Reel, 3000
SGM41566-405A22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405A22XTDE8G/TR	04Z XXXX	Tape and Reel, 3000
SGM41566-405A33	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405A33XTDE8G/TR	051 XXXX	Tape and Reel, 3000
SGM41566-405A55	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405A55XTDE8G/TR	054 XXXX	Tape and Reel, 3000
SGM41566-405D11	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405D11XTDE8G/TR	04Y XXXX	Tape and Reel, 3000
SGM41566-405D22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405D22XTDE8G/TR	050 XXXX	Tape and Reel, 3000
SGM41566-405D33	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405D33XTDE8G/TR	052 XXXX	Tape and Reel, 3000
SGM41566-405D44	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405D44XTDE8G/TR	053 XXXX	Tape and Reel, 3000
SGM41566-405L21	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405L21XTDE8G/TR	MDY XXXX	Tape and Reel, 3000
SGM41566-405N21	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-405N21XTDE8G/TR	01Z XXXX	Tape and Reel, 3000
SGM41566-415J11	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-415J11XTDE8G/TR	075 XXXX	Tape and Reel, 3000
SGM41566-415L21	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-415L21XTDE8G/TR	MDX XXXX	Tape and Reel, 3000
SGM41566-420B04	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-420B04XTDE8G/TR	076 XXXX	Tape and Reel, 3000
SGM41566-420J04	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-420J04XTDE8G/TR	MDZ XXXX	Tape and Reel, 3000
SGM41566-420O22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-420O22XTDE8G/TR	077 XXXX	Tape and Reel, 3000
SGM41566-435C33	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-435C33XTDE8G/TR	078 XXXX	Tape and Reel, 3000
SGM41566-435O22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-435O22XTDE8G/TR	0NV XXXX	Tape and Reel, 3000

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41566-440D11	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-440D11XTDE8G/TR	MDQ XXXX	Tape and Reel, 3000
SGM41566-440O22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-440O22XTDE8G/TR	079 XXXX	Tape and Reel, 3000
SGM41566-445O22	TDFN-2×2-8AL	-40℃ to +125℃	SGM41566-445O22XTDE8G/TR	0NW XXXX	Tape and Reel, 3000

NOTE: Contact Factory if other charge voltage and/or charge current are desired.

MARKING INFORMATION

NOTE: XXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

IN to GND ..... -0.3V to 28V
IN Clamp Current or Voltage (1) ..... 10mA or 28V
BAT to GND (When V_{IN} > V_{BAT}) ..... -0.3V to 20V
BAT to GND (When V_{IN} ≤ V_{BAT}) ..... -0.3V to 4.8V
TSEN to GND ..... -0.3V to 6V
TSEN Clamp Current or Voltage (1) ..... 0.3mA or 6V
Package Thermal Resistance
TDFN-2×2-8AL, θ_{JA} ..... 95℃/W
TDFN-2×2-8AL, θ_{JB} ..... 47℃/W
TDFN-2×2-8AL, $\theta_{JC(TOP)}$ ..... 84℃/W
TDFN-2×2-8AL, $\theta_{JC(BOT)}$ ..... 9℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range ..... 2.9V to 19.5V
IN Clamp Current or Voltage (1) ..... 10mA or 19.5V
TSEN Clamp Current or Voltage (1) ..... 0.3mA or 5.5V
Input Effective Capacitance, C_{IN} ..... 0.1μF to 12μF
Output Effective Capacitance, C_{BAT} ..... 1μF to 12μF
Operating Junction Temperature Range ..... -40℃ to +125℃

NOTE:
1. The current limit and voltage limit are set for those values which applies onto the IN or TSEN pin current and voltage source for 10 minutes and should not cause any change to key operation parameters.

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

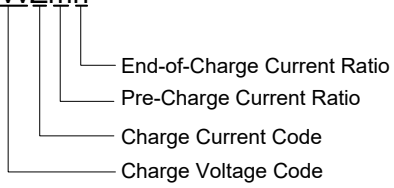
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

SUFFIX CODE FOR CHARGE VOLTAGE AND CHARGE CURRENT

Surfix: vvvZmn

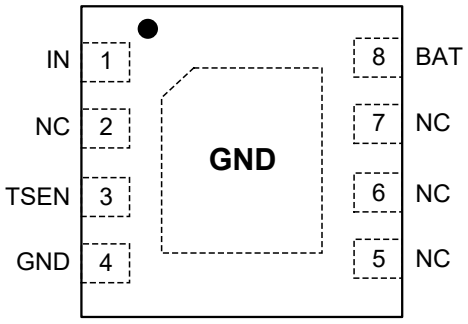


Model: SGM41566-vvvZmn

Charge Voltage (Option Code "vvv")				Charge Current (Option Code "Z")		Pre-Charge Ratio (to Charge Current) (Option Code "m")	
Code	**Voltage (V)**	**Code**	**Voltage (V)**	**Code**	**Current (mA)**	**Code**	**Current Ratio (%)**
350	3.500	**438**	4.375	**A**	50	**0**	No pre-charge
355	3.550	**440**	4.400	**B**	100	**1**	5
360	3.600	**443**	4.425	**C**	150	**2**	10
365	3.650	**445**	4.450	**D**	200	**3**	15
370	3.700	**448**	4.475	**E**	250	**4**	20
375	3.750	**450**	4.500	**F**	300	**5**	25
380	3.800	**453**	4.525	**G**	350	**End-of-Charge Ratio (to Charge Current) (Option Code "n")**	
385	3.850	**455**	4.550	**H**	400		
390	3.900	**458**	4.575	**I**	450		
395	3.950	**460**	4.600	**J**	500	**Code**	**Current Ratio (%)**
400	4.000	**463**	4.625	**K**	550	**1**	5
405	4.050	**465**	4.650	**L**	600	**2**	10
410	4.100	**468**	4.675	**M**	650	**3**	15
415	4.150	**470**	4.700	**N**	700	**4**	20
420	4.200	**473**	4.725	**O**	750	**5**	25
425	4.250	**475**	4.750				
430	4.300	**478**	4.775				
433	4.325	**480**	4.800				
435	4.350						

PIN CONFIGURATION

(TOP VIEW)



TDFN-2×2-8AL

PIN DESCRIPTION

PIN	NAME	TYPE (1)	FUNCTION
1	IN	P	Charge Power Input, for Powering this Device and Feeding to the Charge Output. The capacitor with effective capacitance in the range of 0.1μF to 12μF is recommended. It should be placed close to this pin for decoupling.
3	TSEN	IO	Temperature Sensing and Enable Input. The external connection to this pin is checked, once power input voltage is in the effective range by feeding current (38.6μA) out of the pin. If the pin voltage is less than V_{ENL} (102mV), it is considered as being grounded. The charging function is disabled while the feeding current is reduced to about 25.5μA. If the pin voltage is higher than V_{ENH} (2.68V), charging function is enabled. If the pin voltage is between V_{ENL} and V_{ENH}, it is considered that the NTC thermistor is connected, and the ground resistance is evaluated for temperature safe charging. In this case, charging is allowed, only when the pin voltage is within the range of hot threshold resistance related voltage V_{HOT} to cold threshold related voltage V_{COLD}. The feeding current biases the pin voltage to be higher than V_{COLD} but less than V_{ENH}. If pin voltage in this range is found, it is considered to be excessive cold condition or NTC connection open, charge function is disabled.
4	GND	G	Ground of the Circuit.
8	BAT	O	Output to the Battery and/or System Load for Charging and/or Powering the System Load. The output decoupling capacitor with effective capacitance in the range of 1μF to 12μF is recommended. The pin sinks about 4μA if the pin voltage is higher than charging voltage, and the pin sinks about 1.5mA if output clamp is triggered.
2, 5, 6, 7	NC	NC	No Internal Connection.
Exposed Pad	GND	—	Exposed Pad. Exposed pad is internally connected to GND. Connect it to a large ground plane to maximize thermal dissipation.

NOTE:
1. P = Power, IO = Input and Output, G = Ground, O = Output, NC = No Connection.

ELECTRICAL CHARACTERISTICS

(V_{IN} = ($V_{CHG(NOM)}$ + 0.5V) or 5V (whichever is greater), V_{TSEN} = 0.4V, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}			2.9		19.5	V
Charge Voltage Range	V_{CHG}	V_{CHG} option range		3.5		4.8	V
Charge Current Range	I_{CHG}	I_{CHG} option range		50		750	mA
Input Clamp Voltage	V_{OV}	I_{IN} = 10mA		20	21	22	V
Input Clamp Current	I_{OV}	V_{IN} = 22V		18	26	33	mA
Pass On-Resistance	R_{ON}	I_{IN} = 90% × I_{CHG}, V_{BAT} = 3V, I_{CHG} ≥ 200mA			0.6	1.1	Ω
BAT Leakage	$I_{STANDBY}$	V_{BAT} = 95% × V_{CHG}, IN floating, T_J = -40℃ to +85℃			1	3	μA
		V_{BAT} = 95% × V_{CHG}, V_{TSEN} = 0V, T_J = -40℃ to +85℃			1	8	
		V_{BAT} = 95% × V_{CHG}, TSEN floating, T_J = -40℃ to +85℃			2.4	8	
Input Current	I_Q	V_{TSEN} = 0V, charging disabled			66	95	μA
		V_{TSEN} = 5V, charging terminated			80	125	
		V_{TSEN} = 0.4V, charging terminated			125	180	
In-Charging Current	I_{GND}	V_{BAT} = 90% × V_{CHG}, GND current during charge			0.4% × I_{BAT}		mA
Under-Voltage Lockout Thresholds	V_{UVLOr}	V_{IN} rising		2.65	2.74	2.82	V
	V_{UVLOf}	V_{IN} falling		2.33	2.42	2.50	
IN-BAT Offset Voltage	V_{OS}	I_{IN} = 0.3mA to 80mA, V_{BAT} = 90% × V_{CHG}		35	80	120	mV
IN-BAT Forward Threshold Voltage (1)	V_{DH}	V_{BAT} = 3V, I_{CHG} ≤ 200mA, charge current rise to 95% × I_{CHG}			130	260	mV
IN-BAT Reverse Threshold Voltage	V_{DL}				22		mV
BAT Discharge Current	I_{OV_BAT}	V_{BAT} = 104% × V_{CHG}		1	1.5	2	mA
BAT Activation Voltage Threshold	V_{BAT_ACT}	During the active charge time			2.74		V
Normal Charge, Charge Termination							
Charge Voltage	V_{CHG}	Option voltage raster step			25		mV
Charge Voltage Accuracy		I_{BAT} = 1mA	T_J = +25℃	-20		20	mV
			T_J = +2℃ to +43℃	-25		25	
			T_J = -40℃ to +85℃	-32		28	
Floating Drop Ratio	V_{FCHG}/V_{CHG}	Percentage drop to the V_{CHG}		1.5	2	2.5	%
Recharge Drop Ratio	V_{RECHG}/V_{CHG}	Percentage drop to the V_{CHG}		2.6	4	5.2	%
Pre-Charge Voltage Ratio	V_{PRECHG}/V_{CHG}	Percentage to the V_{CHG}		62.5	65	67	%
Charge Current	I_{CHG}	Option current raster step			50		mA
Charge Current Accuracy		V_{BAT} = 80% × V_{CHG}, I_{CHG} < 150mA	T_J = +25℃	-8		8	%
			T_J = -40℃ to +85℃	-10		10	
		V_{BAT} = 80% × V_{CHG}, I_{CHG} ≥ 150mA	T_J = +25℃	-5		5	%
			T_J = -40℃ to +85℃	-7		7	

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN} = ($V_{CHG(NOM)}$ + 0.5V) or 5V (whichever is greater), V_{TSEN} = 0.4V, T_J = -40℃ to +125℃, typical values are at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Normal Charge, Charge Termination							
Pre-Charge Current Ratio	I_{PRE}/I_{CHG}	Percentage to the I_{CHG}, T_J = -40℃ to +85℃	Ratio = 5%	2.8	5	7.2	%
			Ratio = 10%	7.0	10	13.0	
			Ratio = 15%	11.5	15	18.5	
			Ratio = 20%	15.5	20	24.5	
			Ratio = 25%	19.5	25	30.5	
End-of-Charge Current Ratio	I_{EOC}/I_{CHG}	Percentage to the I_{CHG}, T_J = -40℃ to +85℃	Ratio = 5%	3.0	4.8	6.6	%
			Ratio = 10%	7.4	9.8	12.2	
			Ratio = 15%	11.2	14.8	18.4	
			Ratio = 20%	15.2	19.6	24.0	
			Ratio = 25%	19.0	24	29.0	
Timings for Charge-Recycle, Floating Charge, Charge Termination							
Active Charging Time	t_{ACT}	Charging with I_{CHG} when starting from V_{BAT} < V_{BAT_ACT}			12.5		ms
Charging Recycle Time	t_{HOLD}	The time holds previous charging state before recycle			650		ms
Pre-Charge Voltage Deglitch Time (2)	t_{D_TRK}	T_J = -40℃ to +85℃		2.4	3.8	5.2	ms
Floating Charge Time (2)	t_{FLT}	Floating time for $t_{FLT}/2$ ~ t_{FLT} for charge termination, T_J = -40℃ to +85℃		37	45	53	min
Pre-Charge Safety Time (2)	t_{SAFE}	T_J = -40℃ to +85℃		74	94	114	min
Operation Conditions and Limits							
NTC Sensing Current	I_{NTC_EN}	V_{TSEN} = V_{HOT} to V_{COLD}		37.2	38.6	40.2	μA
	I_{NTC_DIS}	V_{TSEN} = 0V		24.0	25.5	27.0	
Equivalent Resistance	$R_{0.5℃}$	Reference to the NCP15XH103F03RC (β3380)		26.74	27.37	28.00	kΩ
	$R_{45℃}$			4.836	4.95	5.064	
NTC Dismissal Threshold	V_{ENH}	TSEN rising		2.54	2.68	2.85	V
NTC Dismissal Threshold Hysteresis	V_{ENHHYS}	TSEN falling			30		mV
NTC Cold Threshold	V_{COLD}	TSEN rising		1.035	1.057	1.080	V
Cold Threshold Hysteresis	$V_{COLDHYS}$	TSEN falling			165		mV
NTC Hot Threshold	V_{HOT}	TSEN falling		182	191	200	mV
Hot Threshold Hysteresis	V_{HOTHYS}	TSEN rising			33		mV
Shutdown Threshold	V_{ENL}	TSEN falling		92	102	112	mV
Shutdown Threshold Hysteresis	V_{ENLHYS}	TSEN rising			15		mV
Thermal Fold-Back Threshold	T_{FOLD}				145		℃

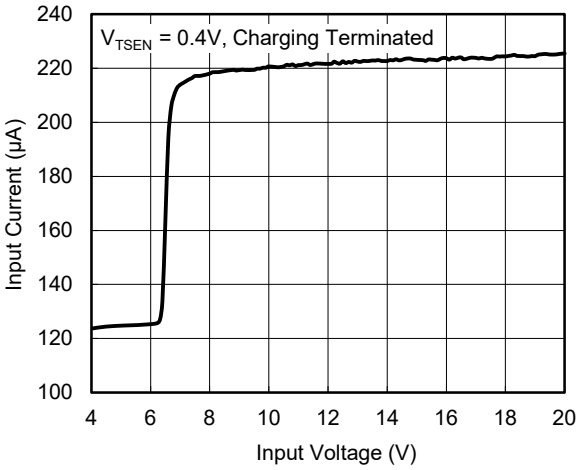
NOTES:

1. V_{IN} - V_{BAT} need more than 95% × I_{CHG} × R_{ON} when I_{CHG} > 200mA.
2. Guaranteed by design and characterization. Not production tested.

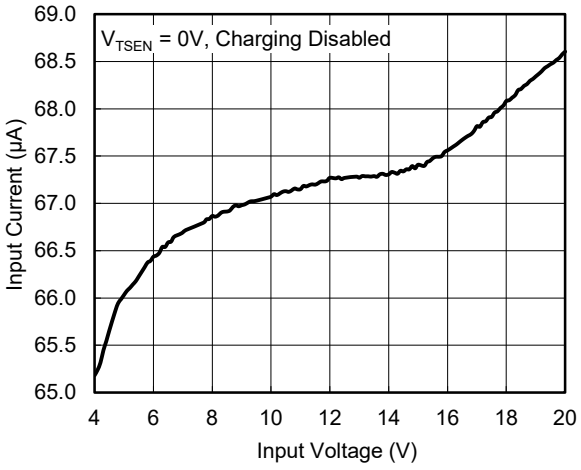
TYPICAL PERFORMANCE CHARACTERISTICS

Measured by SGM41566-360F41, V_{IN} = 5V, V_{TSEN} = 0.4V, T_J = +25℃, unless otherwise noted.

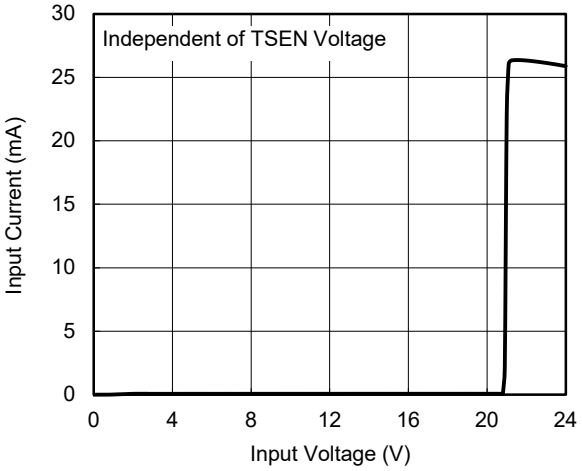
Input Current vs. Input Voltage



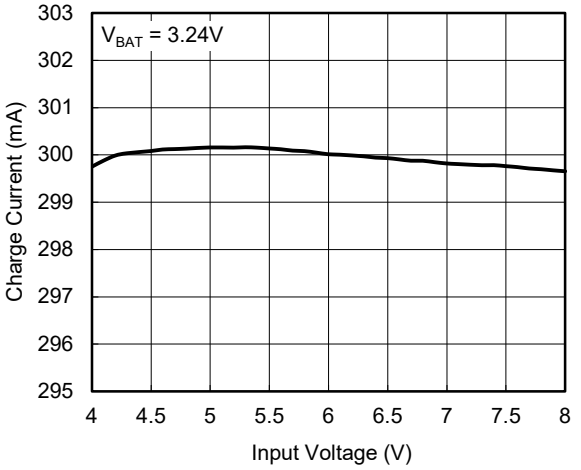
Input Current vs. Input Voltage



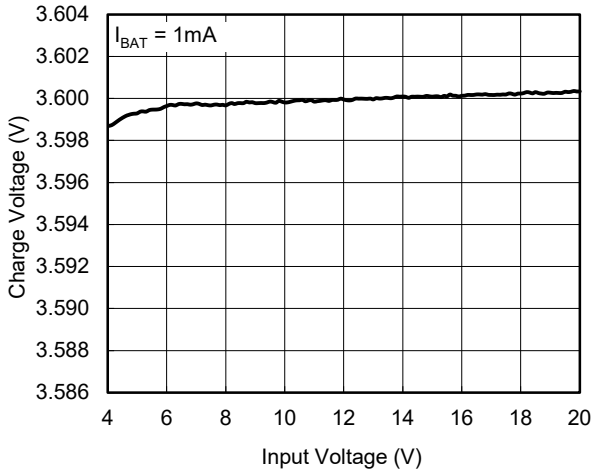
Input Current vs. Input Voltage



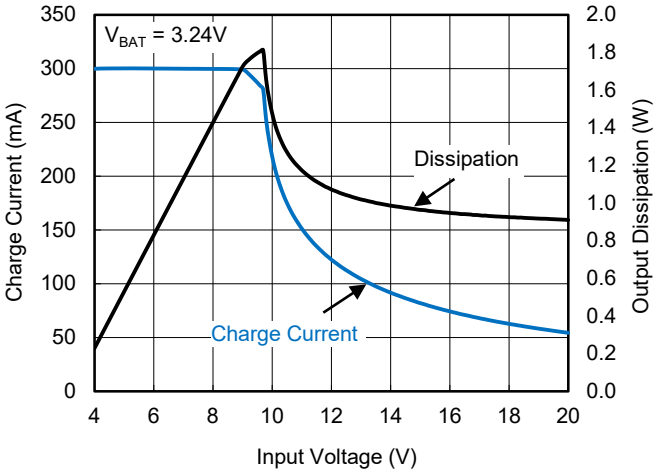
Charge Current vs. Input Voltage



Charge Voltage vs. Input Voltage



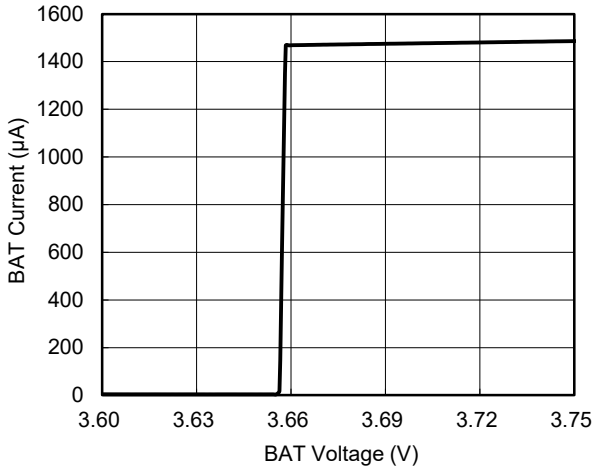
Charge Current and Dissipation vs. Input Voltage



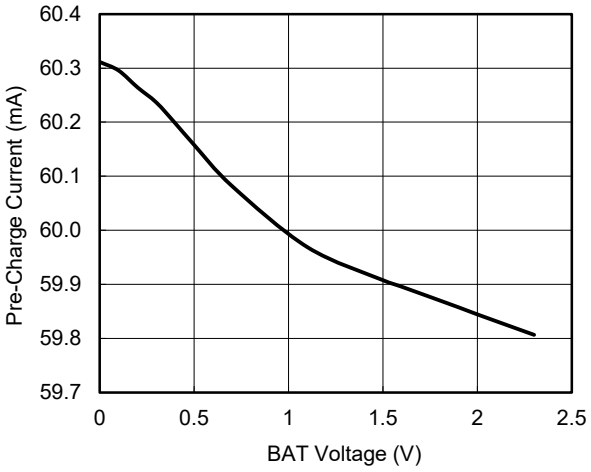
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Measured by SGM41566-360F41, V_{IN} = 5V, V_{TSEN} = 0.4V, T_J = +25℃, unless otherwise noted.

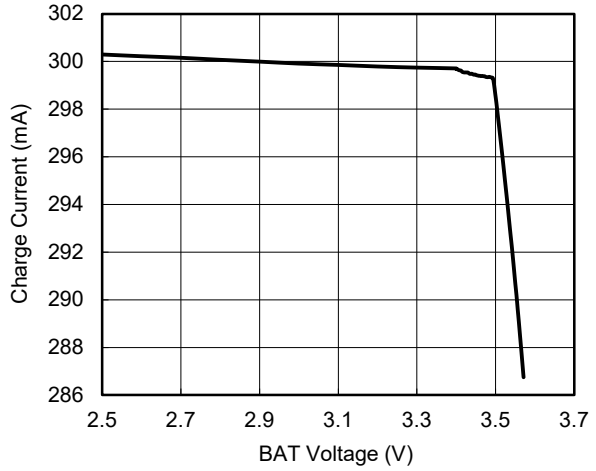
BAT Current vs. BAT Voltage



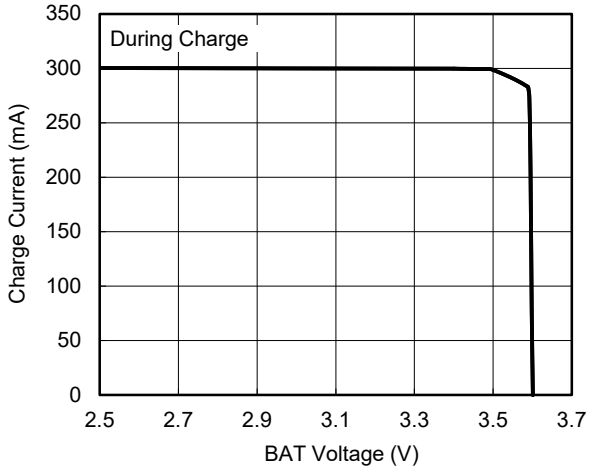
Pre-Charge Current vs. BAT Voltage



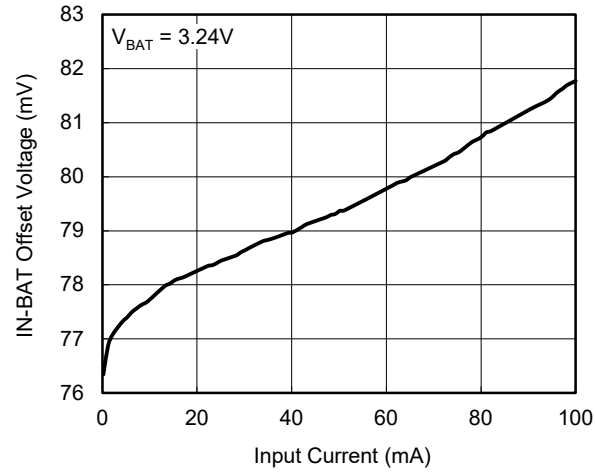
Charge Current vs. BAT Voltage



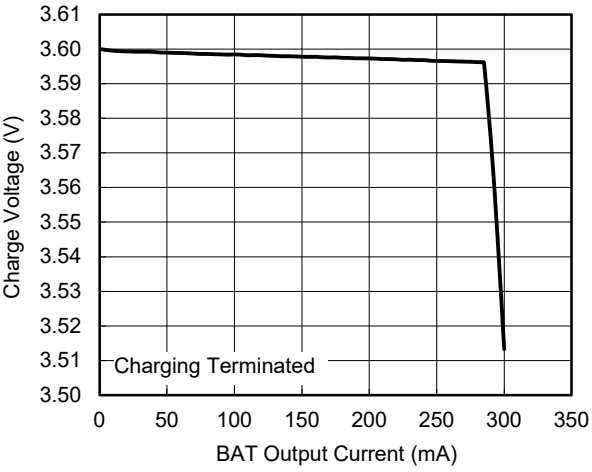
Charge Current vs. BAT Voltage



IN-BAT Offset Voltage vs. Input Current



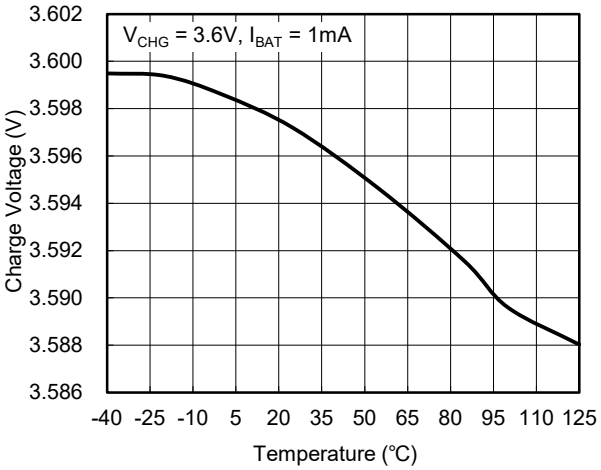
Charge Voltage vs. BAT Output Current



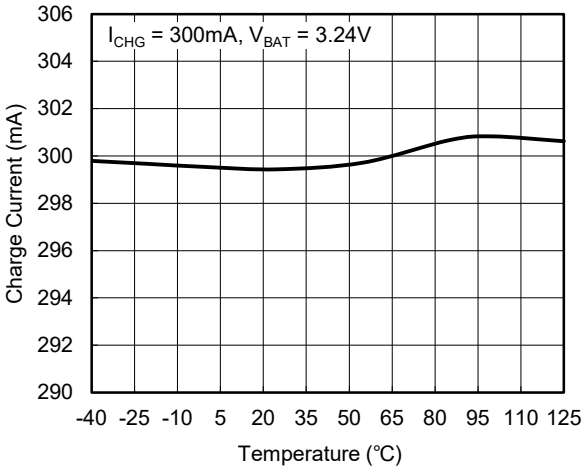
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Measured by SGM41566-360F41, V_{IN} = 5V, V_{TSEN} = 0.4V, T_J = +25℃, unless otherwise noted.

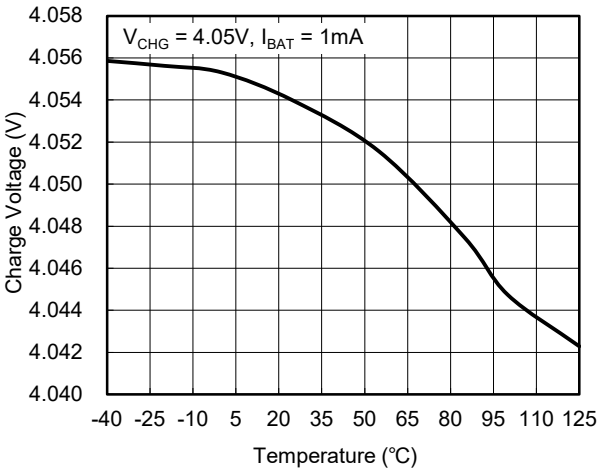
Charge Voltage vs. Temperature



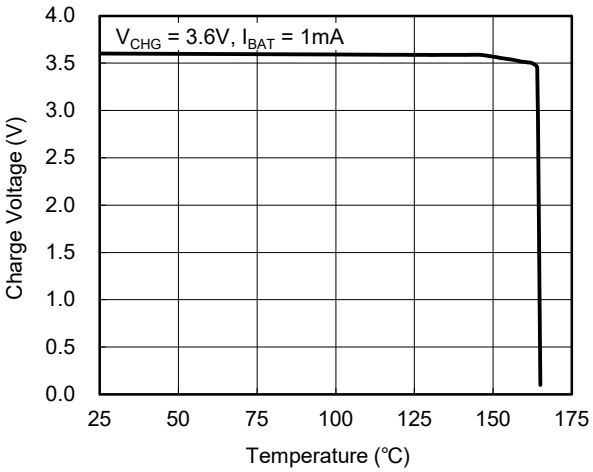
Charge Current vs. Temperature



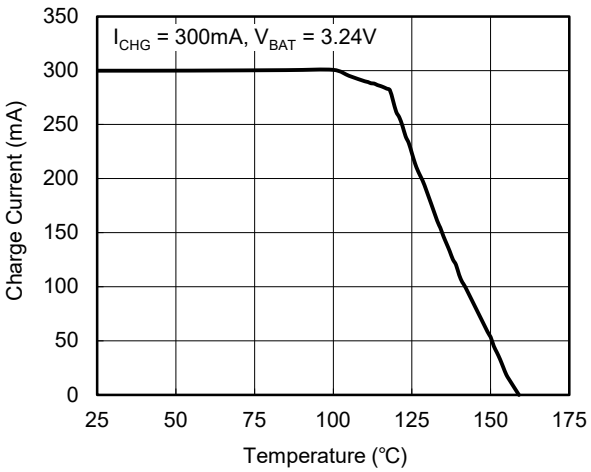
Charge Voltage vs. Temperature



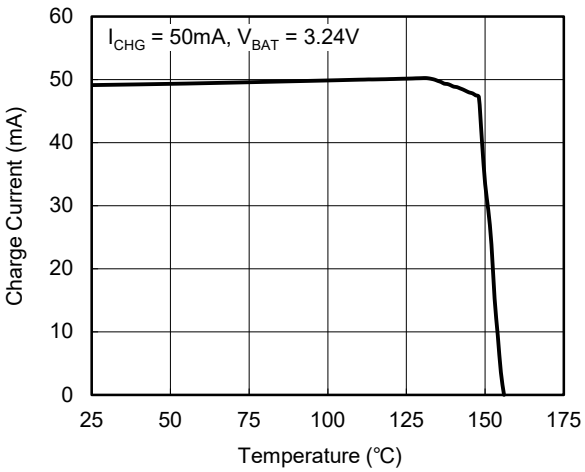
Charge Voltage vs. Temperature



Charge Current vs. Temperature



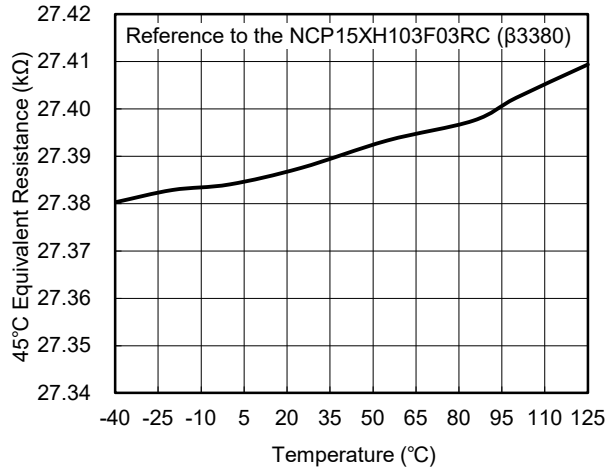
Charge Current vs. Temperature



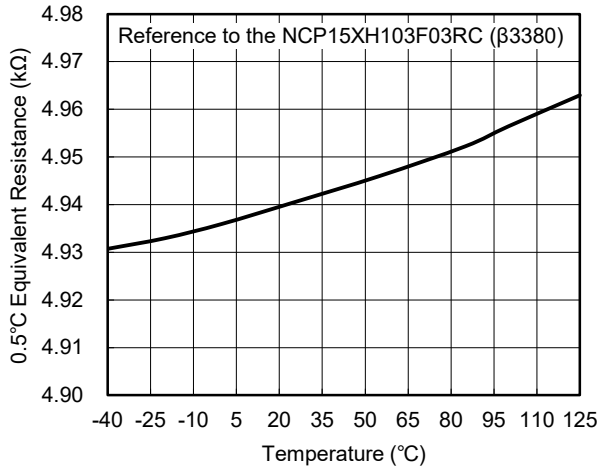
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Measured by SGM41566-360F41, V_{IN} = 5V, V_{TSEN} = 0.4V, T_J = +25℃, unless otherwise noted.

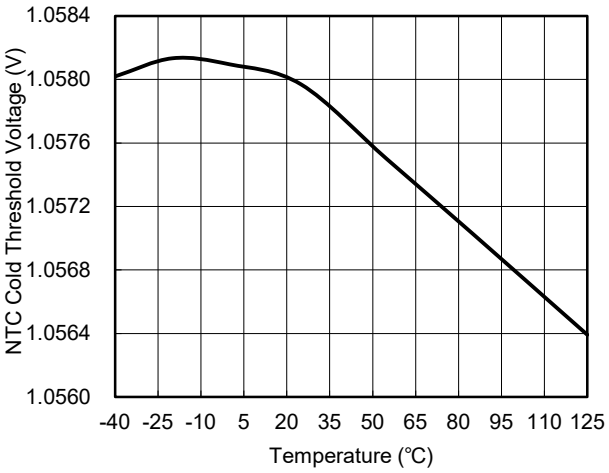
45℃ Equivalent Resistance vs. Temperature



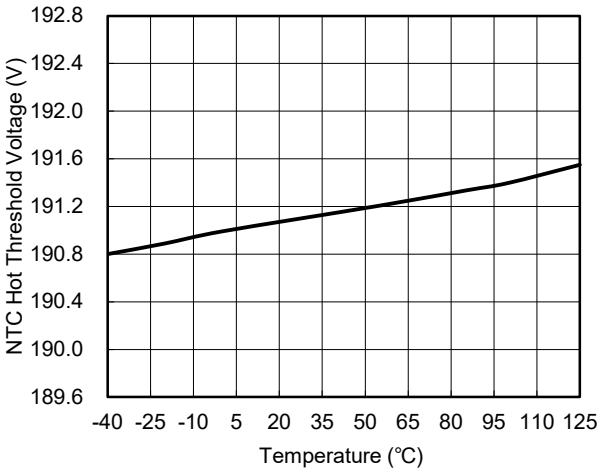
0.5℃ Equivalent Resistance vs. Temperature



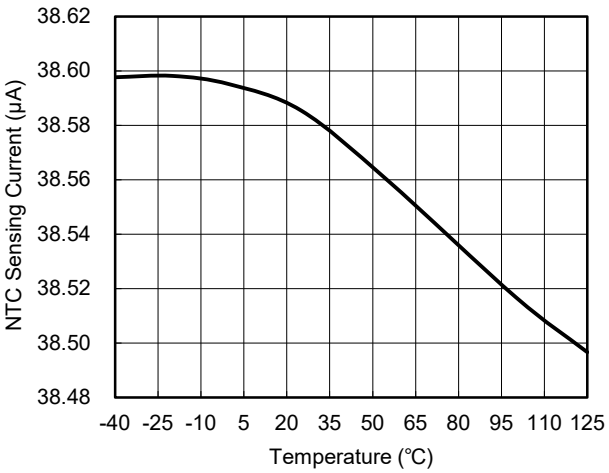
NTC Cold Threshold Voltage vs. Temperature



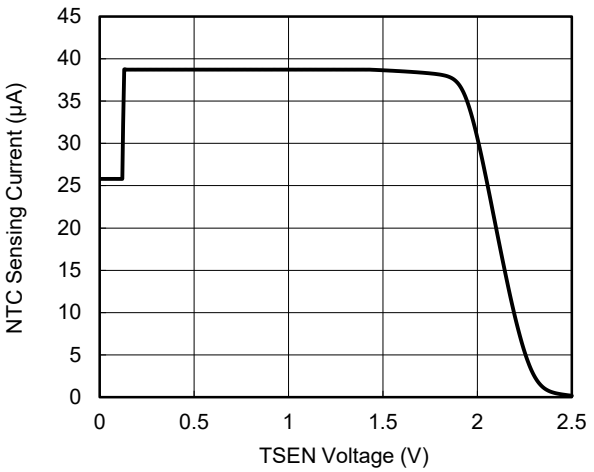
NTC Hot Threshold Voltage vs. Temperature



NTC Sensing Current vs. Temperature



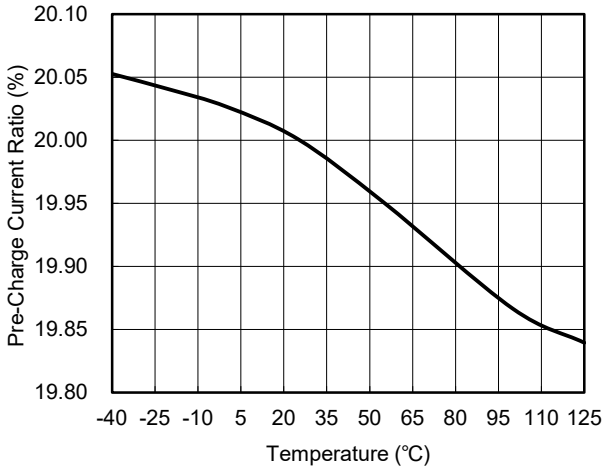
NTC Sensing Current vs. TSEN Voltage



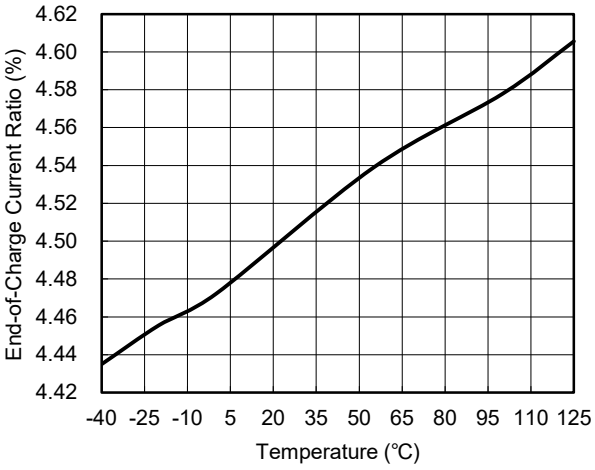
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Measured by SGM41566-360F41, V_{IN} = 5V, V_{TSEN} = 0.4V, T_J = +25℃, unless otherwise noted.

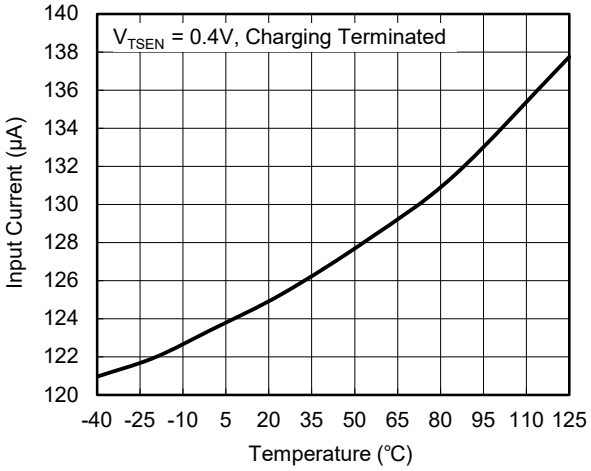
Pre-Charge Current Ratio vs. Temperature



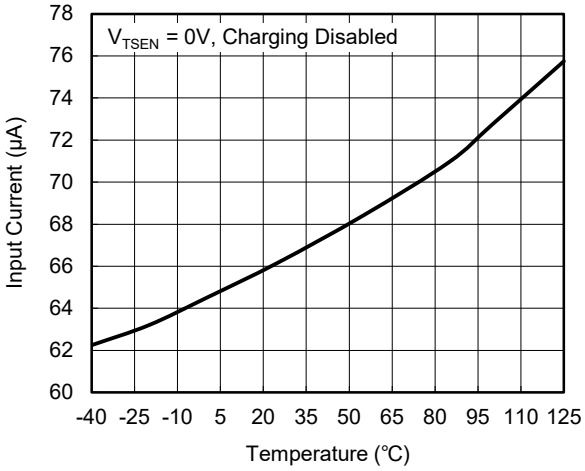
End-of-Charge Current Ratio vs. Temperature



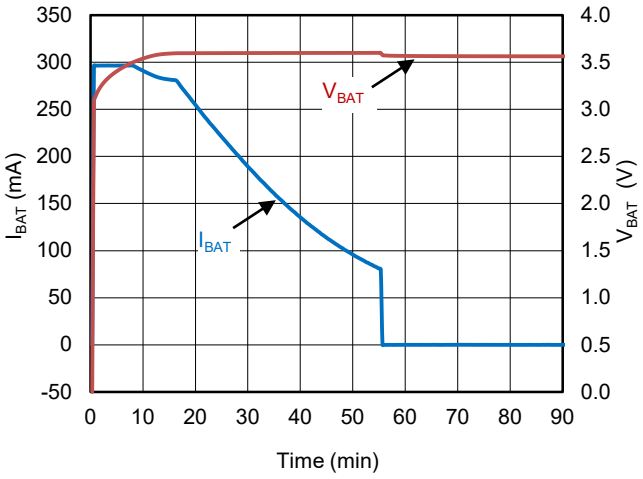
Input Current vs. Temperature



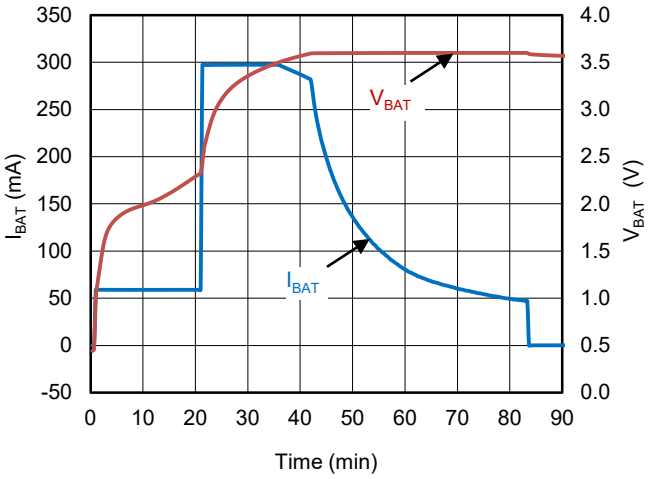
Input Current vs. Temperature



Charge Profile (with Protector)



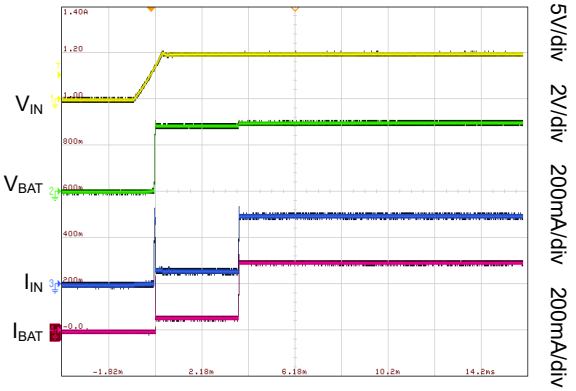
Charge Profile (without Protector)



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

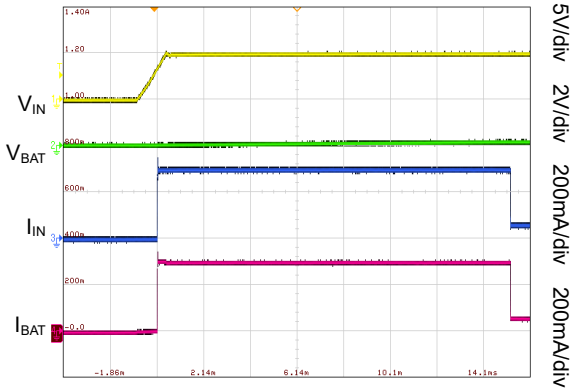
Measured by SGM41566-360F41, V_{IN} = 5V, V_{TSEN} = 0.4V, T_J = +25℃, unless otherwise noted.

V_{IN} Power-Up (with Protector)



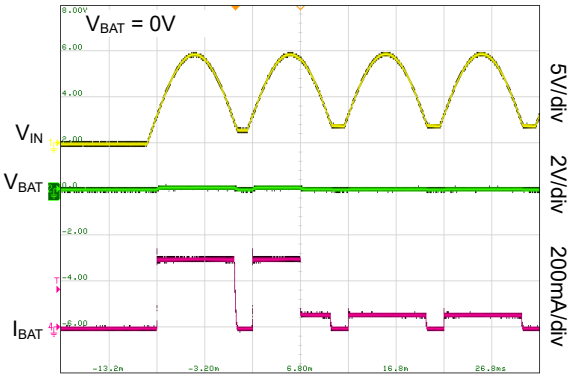
Time (2ms/div)

V_{IN} Power-Up (without Protector)



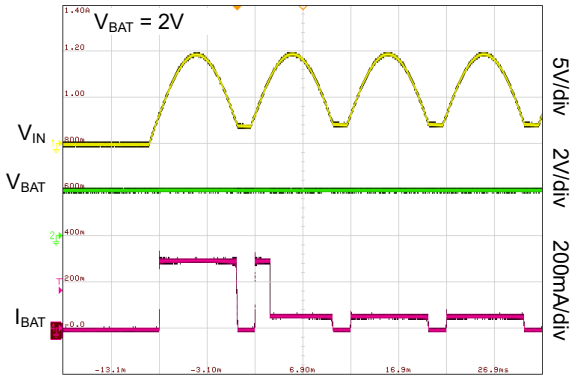
Time (2ms/div)

Rectified 50Hz Input Charging Waveforms



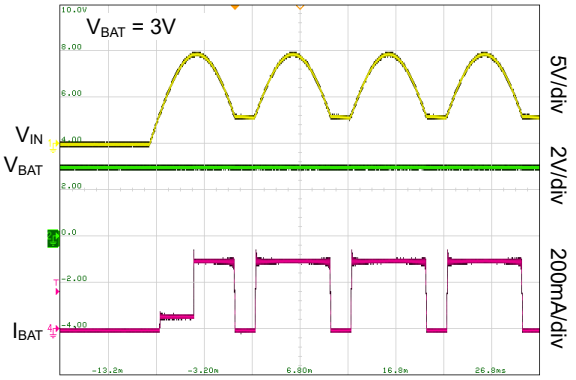
Time (5ms/div)

Rectified 50Hz Input Charging Waveforms



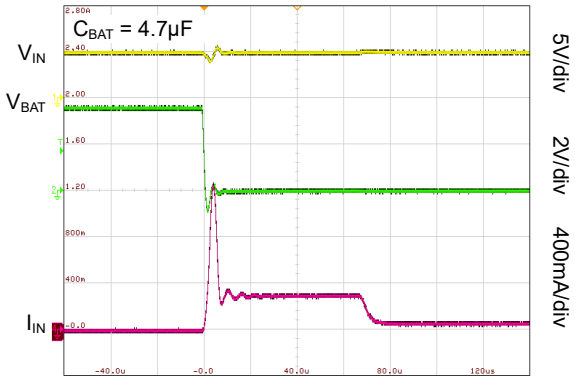
Time (5ms/div)

Rectified 50Hz Input Charging Waveforms



Time (5ms/div)

BAT Short



Time (20μs/div)

CHARGE CYCLE DIAGRAM

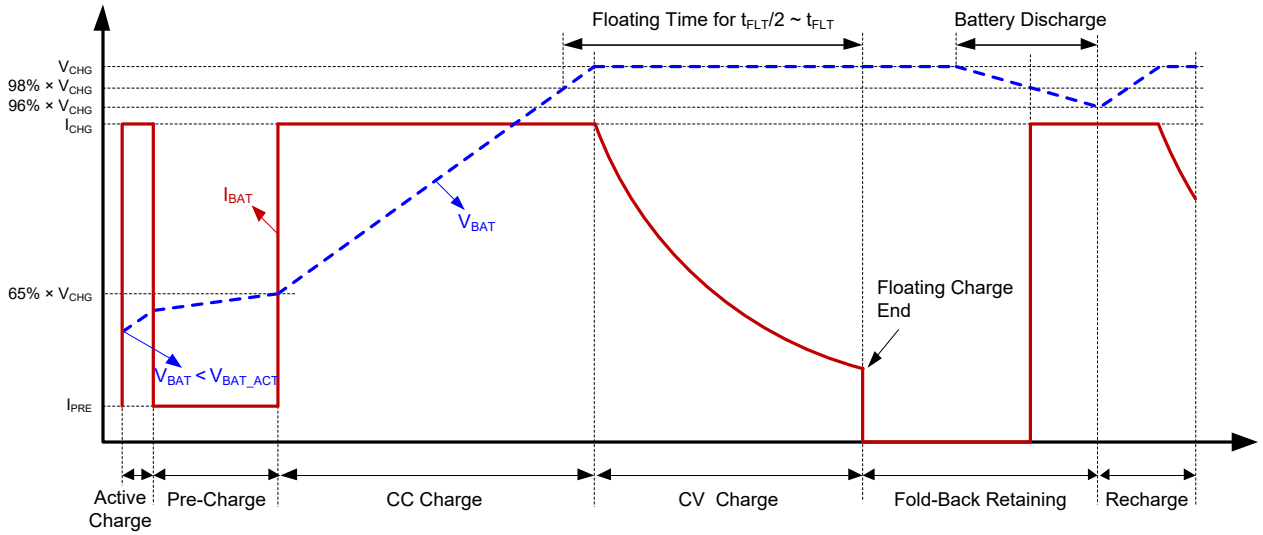


Figure 2. Not-Time Scaled Illustrative Charge Profile (with Active Charge)

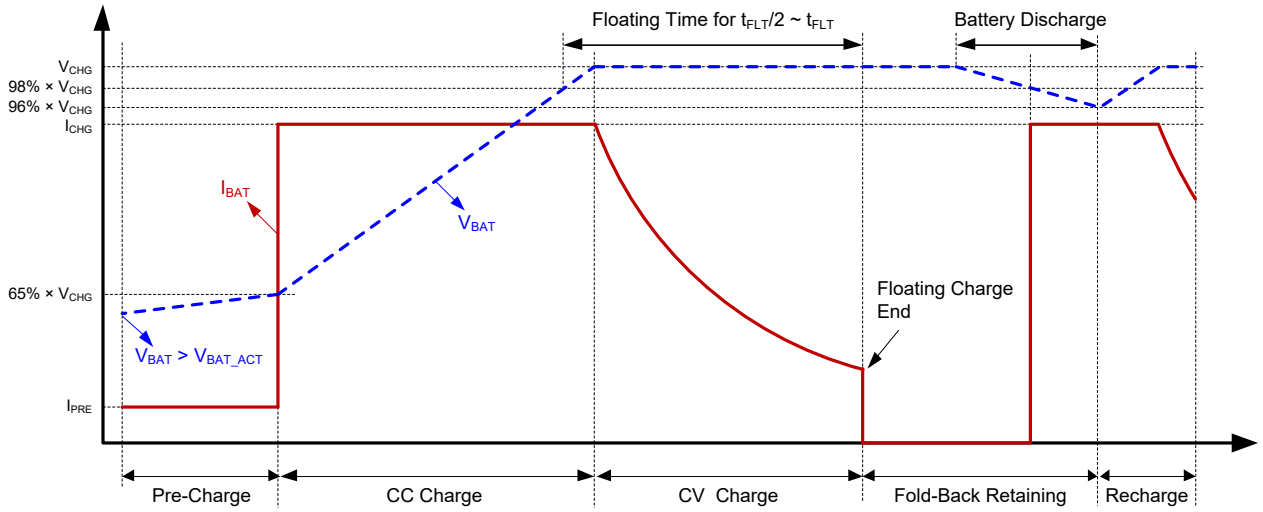


Figure 3. Not-Time Scaled Illustrative Charge Profile (without Active Charge)

FUNCTIONAL BLOCK DIAGRAM

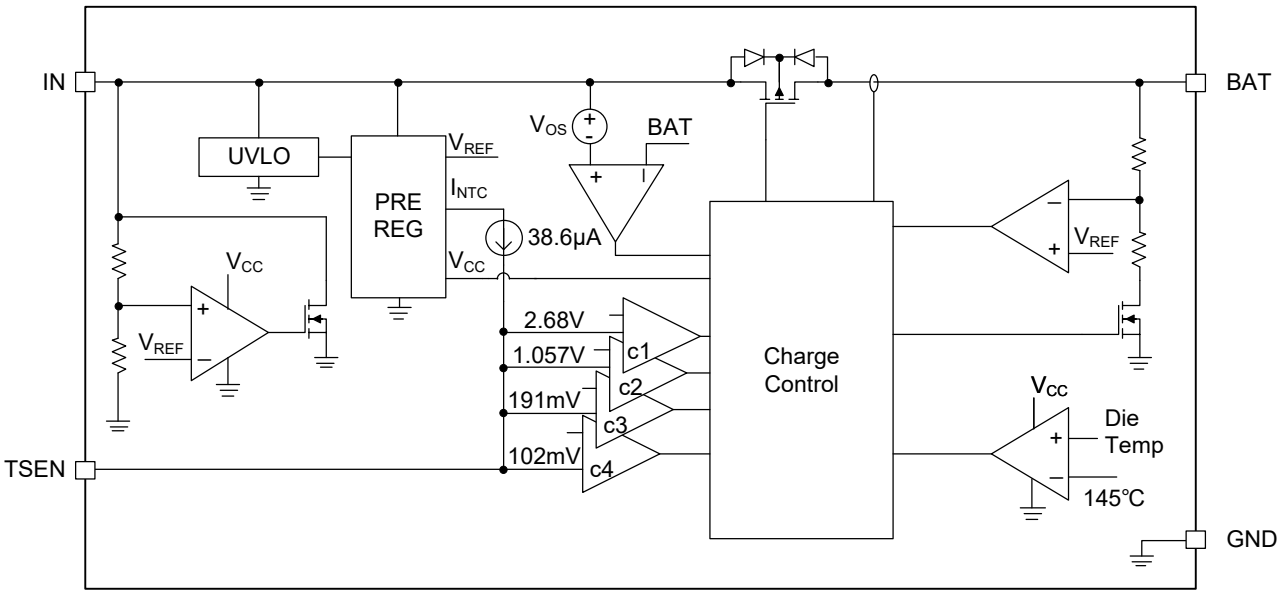


Figure 4. Block Diagram

DETAILED DESCRIPTION

The SGM41566 is a constant-voltage and constant- current profile charge regulator with the input condition check. It features with input clamp, output clamp, die temperature regulation, NTC temperature-oriented protection and floating charging protection. As shown in Figure 1, there are only few external components desired. Figure 2 and Figure 3 show the illustrative charge profiles.

System Start-Up Pre-Charge

When the input is applied and the BAT pin voltage is less than both the pre-charge threshold voltage and activation threshold voltage, the device outputs the constant normal charge current for t_{ACT}, which supplies for the system load to start up in no battery situation or the battery in protection off, before it turns into pre-charge where the output current may not be enough to start up the system.

Wide Charge Available Input Range

Charging is kept when the input voltage is higher than the nominal input range, or when the supply cannot keep voltage and current stable. The charge current is regulated to prevent over-heating when the input voltage is at the higher range end, and it keeps conduction and maintains minimum forward drop-out when the input voltage is at the lower range end. It can charge from pulse train input such as half-sine wave of rectified AC and slow change source like solar cell photo-voltage, while it keeps charge state flags until the internal bias losses or the input stays low for long enough.

Voltage Fold-Back Power Retaining

When the end-of-charge condition is certified, it lowers the output to the safe voltage V_{FCHG}, while keeping the current limit at the level of normal charge and retaining power to the load system. The design avoids frequent discharging and recharging cycling in the situation that charge supply is always attached.

Minimum Floating Charge Time

When the charging current with high system load that sinks more than the residual end-of-charge current and the battery voltage stays higher than the floating charge voltage for over t_{FLT} duration, the battery will stop charging and enter the end-of-charge fold-back power retaining state. As a weak source, it may also cause the current to fall to less than the residual end-of-charge current, and minimum floating charge time > t_{FLT}/2 is a part of condition for full-of-charge certification.

Over-Temperature Charge Regulation

The device senses the die temperature. The thermal fold-back function starts to reduce the charge current when the internal temperature reaches the typical value of +145℃.

BAT Over-Voltage Protection

When any leakage or transient pulls V_{BAT} higher than 104% × V_{CHG} in charge, the BAT sinks current with 1.5mA clamp current for protection.

Full-of-Charge and Input Clamp

When the full-of-charge is certified, the input I_{IN} drops low and the output voltage steps down from V_{CHG} to V_{FCHG}. The sudden current changes the signals to the source side for turning into the full-of-charge state, and the source side can read the state by checking the output voltage or current. In case of wireless or contactless charging with high open load voltage, the device clamps its input voltage to about 21V with 26mA sinking.

NTC Temperature Sensing and Enable

The TSEN sources current (38.6μA) is used to read ground resistance for temperature-oriented protection. A grounded NTC thermistor is connected to the TSEN pin for temperature sensing. Charging is allowed only when the temperature is in suitable range. When a β3380 R_{25} 10kΩ NTC is used, the precise upper and lower thresholds are 45℃ and 0.5℃, respectively.

Pull the TSEN to ground to disable charge function, and pull the TSEN to high voltage > 2.68V to dismiss the temperature-oriented protection function, while enables charge.

Pre-Charge Safety Time

To avoid further damage to bad battery or wrong system load, if the BAT pin voltage cannot reach 65% × V_{CHG} for over t_{SAFE} (94 minutes), the charging will be stopped. However, for the 50Hz rectified input voltage waveform, when the input voltage is lower than V_{UVLOf}, the SGM41566 has no such protection function.

This protection function is not available for the "No pre-charge" option.

REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

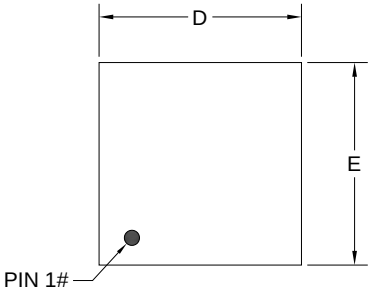
NOVEMBER 2023 – REV.A.1 to REV.A.2	Page
Updated Electrical Characteristics section	7

SEPTEMBER 2023 – REV.A to REV.A.1	Page
Updated Package/Ordering Information section	2, 3

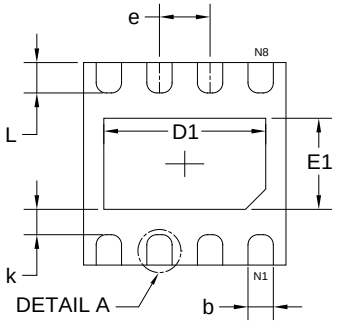
Changes from Original (OCTOBER 2022) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

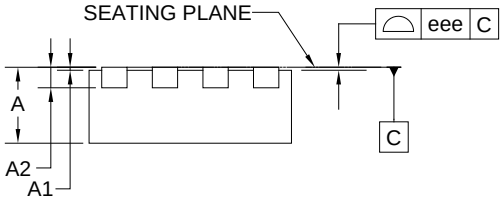
TDFN-2×2-8AL



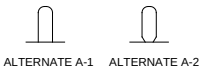
TOP VIEW



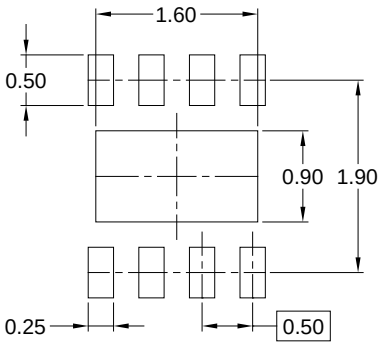
BOTTOM VIEW



SIDE VIEW



DETAIL A
ALTERNATE TERMINAL CONSTRUCTION



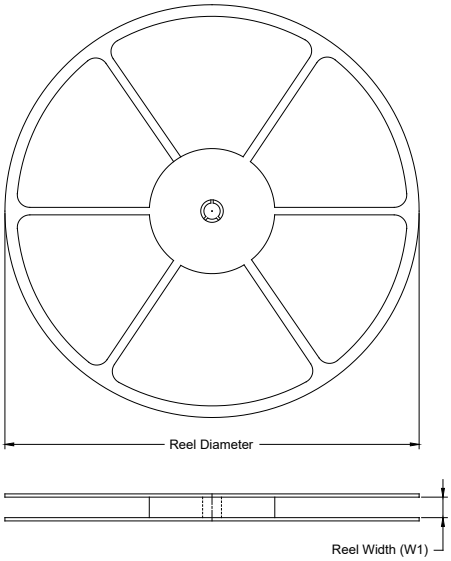
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.700	0.750	0.800
A1	0.000	-	0.050
A2	0.203 REF		
b	0.200	0.250	0.300
D	1.900	2.000	2.100
D1	1.450	1.600	1.700
E	1.900	2.000	2.100
E1	0.750	0.900	1.000
k	0.150	0.250	0.350
e	0.450	0.500	0.550
L	0.200	0.300	0.400
eee	0.080		

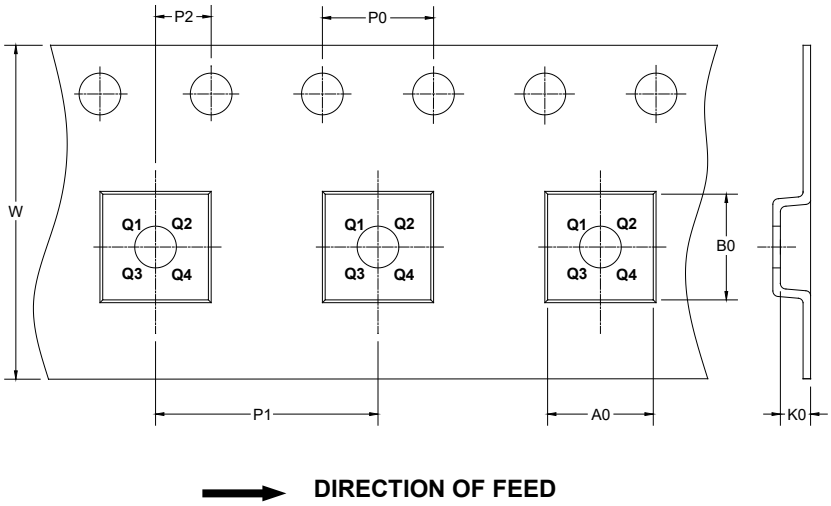
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



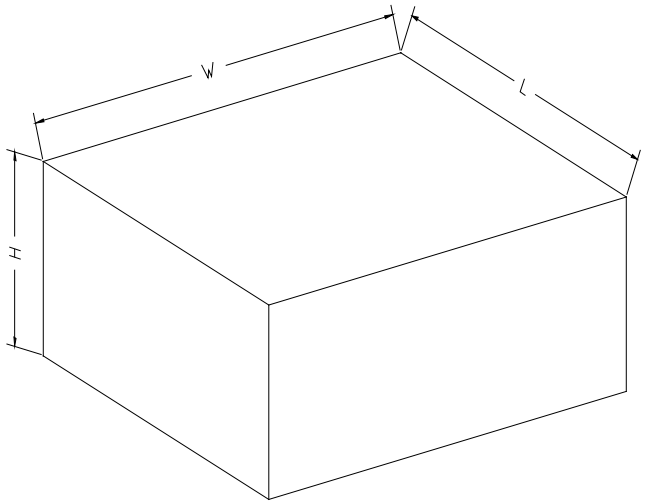
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TDFN-2×2-8AL	7″	9.5	2.30	2.30	1.10	4.0	4.0	2.0	8.0	Q1

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002