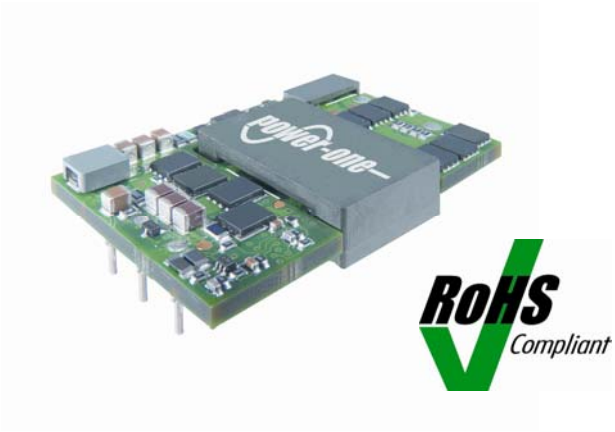


Applications

- Intermediate Bus architectures
- Telecommunications equipment
- LAN/WAN
- Data processing

Features

- RoHS lead-free and lead-solder-exempt products are available
- Delivers up to 418 watts with a 55 VDC input
- Cost-effective, single-board design
- 5:1 Fixed ratio converter
- Ultra-high efficiency 97.0%
- 0.500” height profile (12.70 mm)
- Narrow input range 36 – 55 VDC
- Parallel operation (3 units)
- Input-to-output isolation: 1500 VDC
- Start-up into high capacitive load
- Low conducted and radiated EMI
- Output overcurrent protection
- Input undervoltage lockout
- Input overvoltage shutdown
- Overtemperature protection
- Approved to UL 60950-1/ CAN/CSA-C22.2 No. 60950-1-03, and TUV approved to EN 60950-1, IEC 60950-1

Description

The QTS48T38096 bus converter provides a 5:1 fixed ratio, isolated, step-down voltage. Output voltage is directly proportional to input voltage with a conversion ratio of 5:1, at 48 VDC in the resulting output voltage would be 9.6 VDC. The converter provides ultra-high efficiency up to 97%; as a result very little heat is dissipated and a heat sink is not required.

The QTS48T38096 is an excellent choice for intermediate bus applications where multiple output voltages are required and a 9.6 V rail will be used to power “Point of Load” devices.

Model Selection

Model	Input Voltage VDC	Input Current, Max ADC	Output Voltage Vout,@ 48Vin VDC	Output Current (A)	Output Ripple/Noise, mV p-p (max.)	Typical Efficiency @ 48Vi, 38A
QTS48T38096-NCAP	36-55	8.5	9.6	38	200	97.0

This product is intended for integration into end-use equipment. All the required procedures for CE marking of end-use equipment should be followed.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings may cause performance degradation, adversely effect long-term reliability, and cause permanent damage to the converter.

Parameter	Conditions/Description	Min	Max	Units
Input Voltage	Continuous	0	55	VDC
Operating Temperature	*Case Temperature (Q11)	-40	125	°C
Storage Temperature		-40	125	°C

* If necessary the factory will provide an assembly drawing upon request to locate Q11

Environmental and Mechanical Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Shock	(Half-sinewave, 6ms), 3 axes		50		g
Sinusoidal Vibration	GR-63-CORE, Section 5.4.2		1		g
Weight			1.7/48		Oz/g
Water Washing	Standard process		Yes		
MTBF (Po= 260 W, T_A = 30°C)	Per Bellcore TR-NWT-000332		3.5		MHrs

Isolation Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Insulation Safety Rating		Functional			
Isolation Voltage	Input to Output	1500			VDC
Isolation Resistance		10			MOhm
Isolation Capacitance			1100		pF

Input Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Input Voltage	Continuous	36	48	55	VDC
Turn-On Input Voltage	Ramping Up	33	35	37	VDC
Turn-Off Input Voltage	Ramping Down	31	32	33	VDC
Output Rise Time	Time from Vo @ 10% of nominal to Vo @ 90% of Nominal, w/ Load = 365 W resistor + 3000 µF capacitor	0.5		2	ms
Input Reflected Ripple Current	Full Load, 12 µH source inductance			50	mA p-p
Inrush Transient	Vin=Vin.max			1	A^2s
Input Overvoltage Shutdown Turn-off voltage threshold Turn-on voltage threshold	Vin	 57 55		 59.5 58	

Output Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Output Voltage over line load and temperature		6.2		11.5	VDC
Output Current	Io	0		38	A
Load Regulation	Vo		300	500	mV
Turn-on overshoot	Vo			3	%
Transient response	25% load step change @ 1A/µs (% of Vo nominal)	Vo		± 4	%
Admissible Load Capacitance	I_{rated}, Nom Vin			3000	µF
Output Current Limit Threshold Latch-Off (recycle power or toggle shutdown pin to re-start)	Po	110%	130%	150%	
Switching Frequency			300		kHz

Feature Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Shutdown (ON/OFF)					
Negative Logic	On/Off signal is low – converter is ON				
Converter ON		-0.5		0.8	VDC
Source Current	ON/OFF pin is connected to -Vin			1	mADC
Converter OFF		2.5		20	VDC
Positive Logic	On/Off signal is low–converter is OFF				
Converter ON		2.5		20	VDC
Open Circuit Voltage	ON/OFF pin is floating			5	VDC
Converter OFF		-0.5		0.8	VDC
Overtemperature Protection	Average board temperature	+130		+140	°C
Current Share Accuracy	See Page 4. “Parallel Operation”		5	10	%

Characteristic Curves

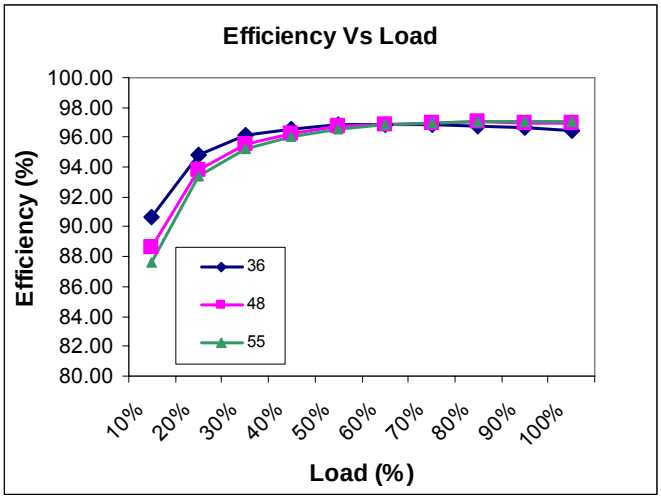


Figure 1. QTS48T38096 Efficiency vs. Output Load

Typical Application

Figure 2 shows the recommended connections for the QTS48T38096 converter.

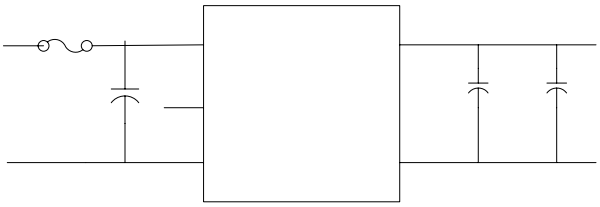


Figure 2. Typical Application of QTS48T38096

The QTS48T38096 converter does not require any external components for proper operation. However, if the distribution of the input voltage to the converter contains significant inductance, a capacitor C1 may be required to enhance performance of the converter. A minimum of a 100 µF electrolytic capacitor with the ESR<0.5Ω at 100 kHz is recommended for the QTS48T38096.

Refer to the "Inrush Current Control Application Note" on www.power-one.com for suggestions on how to limit the magnitude of the inrush current.

For output decoupling we recommend to use a 10µF low ESR tantalum (AVX TPSC106M025R0500 is used in our test setup) and a 1µF ceramic capacitors. Note, that the capacitors do not substitute the filtering required by the load.

Shutdown Feature Description

The ON/OFF pin in the QTS48T38096 converter functions as a normal soft shutdown. It is referenced to the –Vin pin (see Figure 3). With the positive logic, when the ON/OFF pin is pulled low, the output is turned off and the unit goes into a very low input power mode.

With negative logic, when the ON/OFF pin is pulled low, the unit is turned on.

An open collector switch is recommended to control the voltage between the ON/OFF pin and the -Vin pin of the converter. The ON/OFF pin is pulled up internally, so no external voltage source is required. The user should avoid connecting a resistor between the ON/OFF pin and the +Vin pin.

When the ON/OFF pin is used to achieve remote control, the user must take care to insure that the pin reference for the control is really the -Vin pin. The control signal must not be referenced ahead of EMI filtering, or remotely from the unit. Optically coupling the information and locating the optical coupler directly at the module will solve any of these problems.

Note:
If the ON/OFF pin is not used, it can be left floating (positive logic), or connected to the -Vin pin (negative logic).

Parallel Operation

The following precautions must be observed when operating two or more QTS48T38096's in parallel:

1. The inputs of all units must be attached to the same voltage source
2. The PCB trace resistance into each unit should be equalized as much as is practical.
3. The enable pins must be tied together and operated as a single unit.
4. The under voltage lockout start-up point will vary from unit to unit, therefore the dv/dt of the input source as it rises from 0 V to its final value will affect the ability of the parallel units to turn on into a load equal to more that the maximum rated load of 1 unit. The dv/dt of the rising edge of the input voltage must be greater than 2V/mS. If three units are to be operated in parallel, it is strongly recommended that the maximum load current be limited to the maximum current rating of a single unit until the output voltage exceeds 90% of the rated output voltage.
5. The accuracy of the current sharing will be affected by the series impedance between each unit at the load. Balancing these

impedances will enhance the current share accuracy.

6. Figure 2, below, shows the recommended airflow direction, unit orientation and temperature variation of three paralleled units with 10% current share accuracy. Please note that the maximum power available will be reduced by up to 10% due to current share accuracy. (At 48 volts in, the maximum power available would be 350 W X 3unit X 90% derating = 945 W)

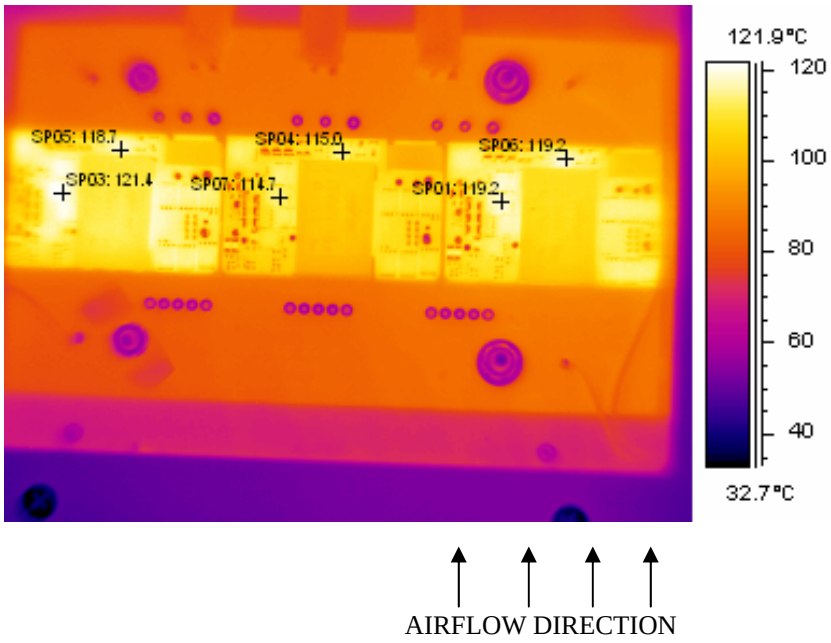


FIGURE 2:
Three units in parallel with 50 V input voltage, 900 W output power, 70 °C ambient, and 200 LFM airflow

Safety Considerations

The QTS48T38096 converter features 1500 VDC isolation from input to output. The input-to-output resistance is greater than 10 MΩ. This converter is provided with functional insulation between input and output circuits according to all IEC60950 based standards. Nevertheless, if the system using the converter needs to receive safety agency approval, certain rules must be followed in the design of the system. In particular, all of the creepage and clearance requirements of the end-use safety requirements must be observed. These documents include UL60950 - CSA60950-00 and EN60950, although other or additional requirements may be needed for specific applications.

The QTS48T38096 converter has no internal fuse. The external fuse must be provided to protect the system from catastrophic failure. The fuse with a rating not greater than 10 A is recommended. The user can select a lower rating fuse based upon the highest inrush transient at the maximum input voltage and the maximum input current of the converter, which occurs at the minimum input voltage. Both input traces and the chassis ground trace (if applicable) must be capable of conducting a current of 1.5 times the value of the fuse without opening. The fuse must not be placed in the grounded input line, if any.

In order for the output of the QTS48T38096 converter to be considered as SELV (Safety Extra Low Voltage) or TNV-1, according to all IEC60950 based standards, one of the following requirements must be met in the system design:

- If the voltage source feeding the module is SELV or TNV, the output of the converter may be grounded or ungrounded.
- If the voltage source feeding the module is ELV, the output of the converter may be considered SELV only if the output is grounded per the requirements of the standard.
- This information is provided for guidance only and the user is responsible for any design considerations regarding safety.

Thermal Considerations

The QTS48T38096 converter is designed for natural or forced convection cooling. The maximum allowable output current of the converter is determined by meeting the derating criteria for all components used in the converter. For example, the maximum semiconductor junction temperature is not allowed to exceed 125 °C to ensure reliable long-term operation of the converter. Contact Power-One for the complete list of the derating criteria.

The graph in figure 4 shows the maximum output current of the QTS48T38096 converter at different ambient temperatures under both natural and forced (transverse airflow direction, from pin 1 to pin 3) convection.

For example, the QTS48T38096 operating at 48 Vin, 70 °C can deliver up to 34 A reliably with 200 LFM forced air.

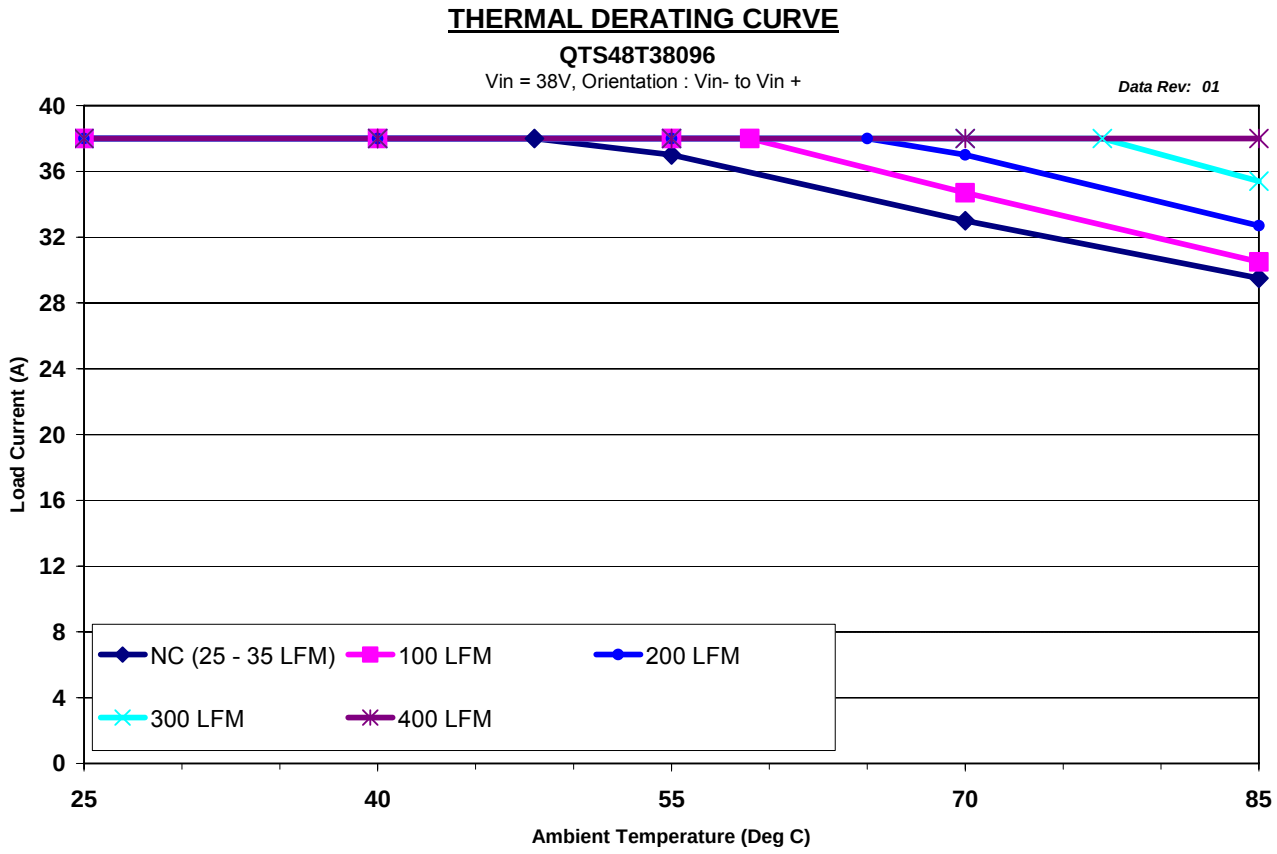


Figure 3. Thermal Derating Curve Vin = 38V, Varying Airflow (Input Voltage Constant)

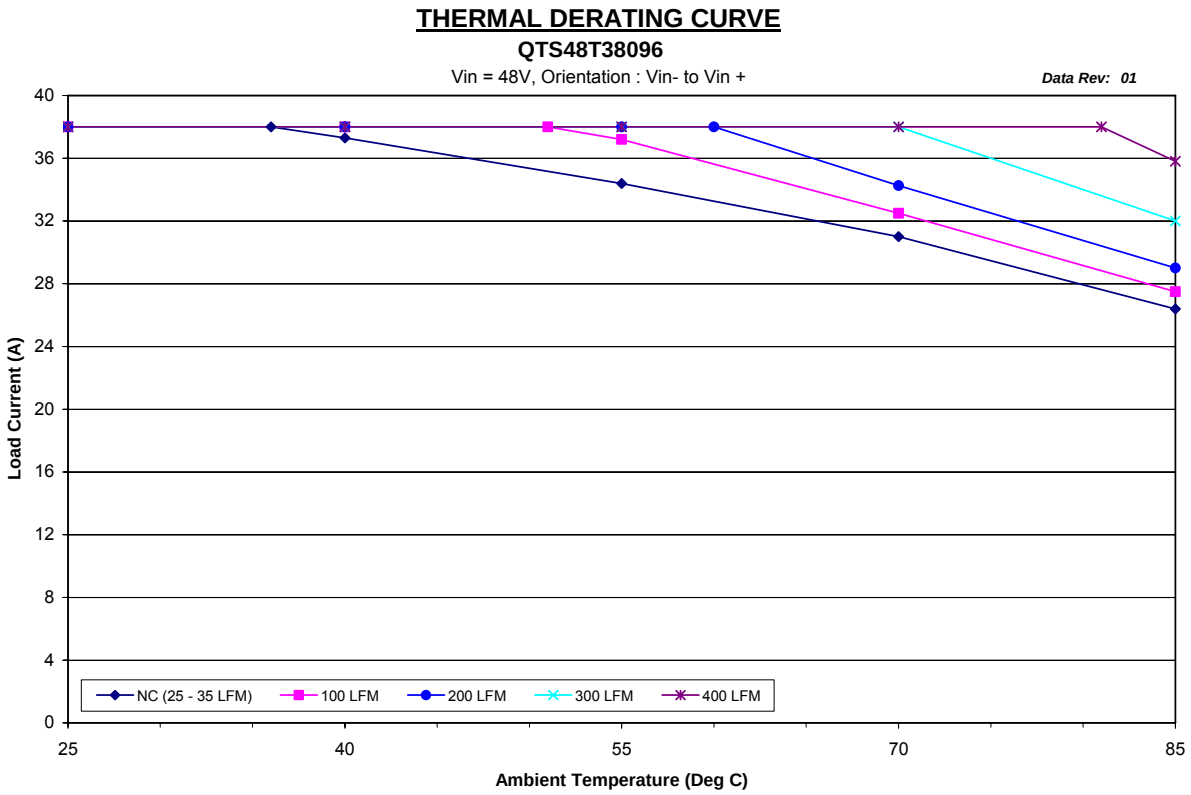
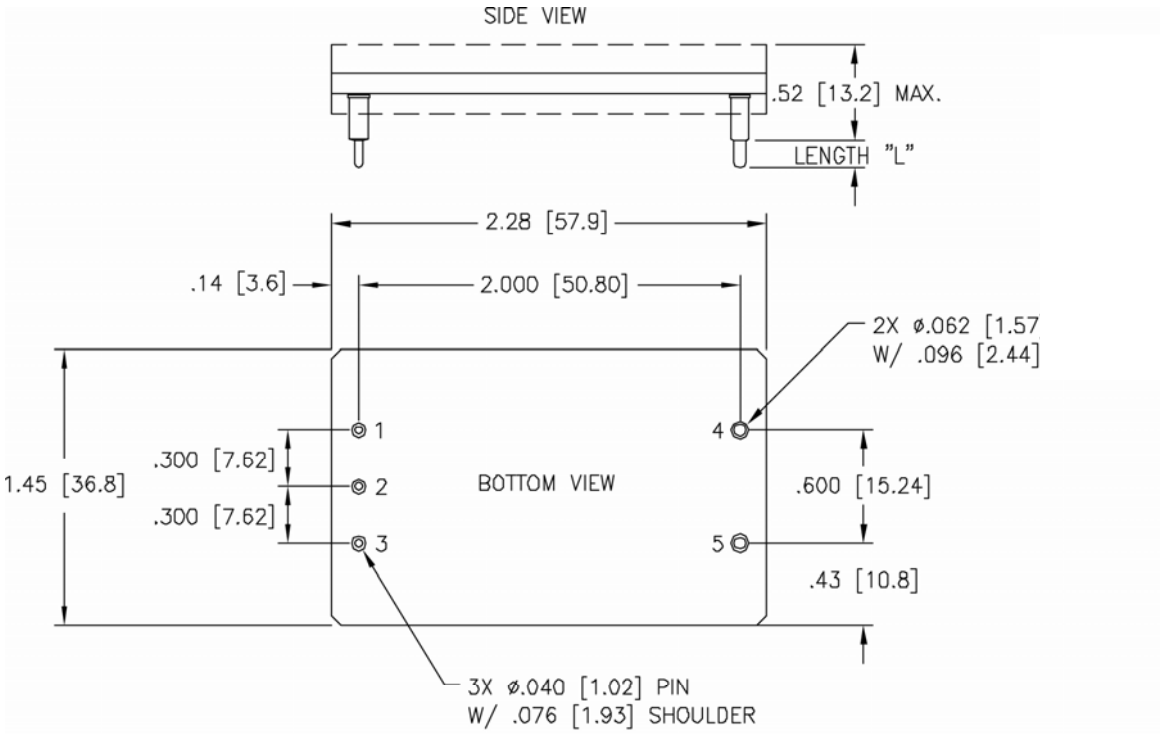


Figure 4. Thermal Derating Curve Vin = 48V, Varying Airflow (Input Voltage Constant)

Mechanical Drawing



PIN	FUNCTION
1	−V IN
2	ENABLE
3	+V IN
4	−V OUT
5	+V OUT

LETTER DESIGNATOR	LENGTH "L" ±.010[0.25]
A	.185[4.7]
B	.145[3.7]
C	.110[2.8]

TOLERANCES
XX = ± .02 [0.5]
XXX = ± .010 [0.25]
PIN DIAMETER TOLERANCE ±.002 [0.05]

Ordering Information

Options	Suffixes to add to part number
Remote ON/OFF	Positive- Standard, -P suffix Negative-Standard, -N suffix
Pin Length	0.18"- Standard, add "CA" suffix
	0.145"- Add "CB" suffix
	0.110"- Add "CC" suffix
Paralleling Option	Paralleling add "P" suffix (standard)

RoHS	Add to Part Number
RoHS lead solder exempt [1]	No RoHS character required.
RoHS compliant for all six substances	Add "G" as the last character of the part number.

[1] The solder exemption refers to all the restricted materials except lead in solder.

Example: QTS with negative logic, 0.180 Pin and Paralleling the resulting part number is QTS48T38096-NCAP