Preliminary

CS-8145

CS-8145

10V, 5V Low Dropout Dual Regulator with ENABLE

Description

The CS-8145 is a low dropout, high current 10V regulator. Also included is a standby 5V/10mA output for powering systems with standby memory. Quiescent current drain is less than 3mA when supplying 10mA loads from the standby regulator.

In automotive applications, the CS-8145 and all regulated circuits are protected from reverse battery installations, as well as two-battery jumps. During line transients, such as a 60V load dump, the 500mA regulator will automatically shut down to protect both internal circuits and the load, while the standby regulator will continue to power any standby load.

The CS-8145 is packaged in a 5-lead TO-220, with copper tab for connection to a heat sink, if necessary.

Features

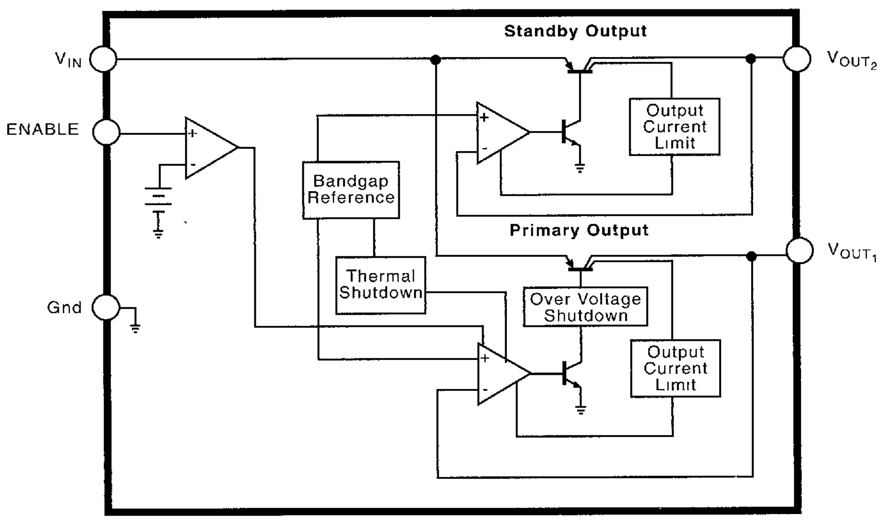
- Two Regulated Outputs
- Primary Output 10V ± 5%; 750mA
- Low Dropout Voltage (0.6V at 0.5A)
- ON/OFF Control Option
- Standby Output 5V ±5%; 10mA
- Low Quiescent Drain (<2mA)
- Protection Features
  - Reverse Battery
  - 60V Load Dump
  - -50V Reverse Transient
  - Short Circuit
  - Thermal Shutdown

Absolute Maximum Ratings

Input Voltage
- Operating Range 26V
- Overvoltage Protection 60V

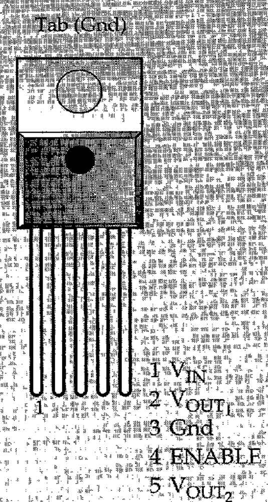
Internal Power Dissipation ....Internally Limited
Operating Temperature Range ....-40°C to +125°C
Maximum Junction Temperature ....150°C
Storage Temperature Range ....-65°C to +150°C
Electrostatic Discharge (Human Body Model) 2kV
Soldering Lead Temperature: TO-220 (10 sec) ....260°C

Block Diagram



Package Options

TO-220 5 Lead



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Electrical Characteristics for V_{OUT_1}: V_{IN} = 14V, I_O = 500mA, -40°C≤T_C≤125°C, -40°C≤T_J≤150°C unless otherwise specified

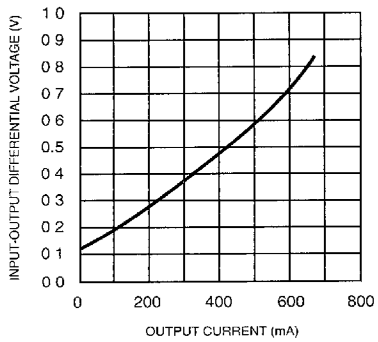
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
■ Output Stage (V_{OUT_1})					
Output Voltage, V_{OUT_1}	11V≤V_{IN}≤26V, I_{OUT_1}≤500mA,	9.4	10.0	10.6	V
Dropout Voltage (V_{IN}-V_{OUT_1})	I_{OUT_1}=500mA			0.60	V
Line Regulation	11V≤V_{IN}≤16V, I_{OUT_1}=5mA		8	40	mV
	1V≤V_{IN}≤26V, I_{OUT_1}=5mA		20	80	mV
Load Regulation	5mA≤I_{OUT_1}≤500mA			100	mV
Quiescent Current	I_{OUT_1}≤10mA, No Load on Standby		3	7	mA
	I_{OUT_1}=500mA, No Load on Standby		40	100	mA
	I_{OUT_1}=750mA, No Load on Standby		90		mA
Ripple Rejection	f=120Hz		53		dB
Current Limit		0.75	1.40	2.50	A
Maximum Line Transient	V_{OUT_2}≤11V	60			V
Reverse Polarity	V_{OUT_2}≥-0.6V, 10Ω Load Input Voltage, DC	-18			V
Reverse Polarity Input Voltage, Transient	1% Duty Cycle, t=100ms, V_{OUT_2}≥-6V, 10Ω Load	-50			V
Output Impedance	500mA_{DC} and 10mA_{rms}, 100Hz-10kHz		200		mΩ
Output Noise Voltage	10Hz-100kHz		100	500	µVrms
Long Term Stability			50		mV/khr
■ Standby Output (V_{OUT_2})					
Output Voltage, V_{OUT_2}	I_{OUT_2}≤10mA,6V≤V_{IN}≤26V	4.75	5.00	5.25	V
Dropout Voltage	I_{OUT_2}≤10mA		0.55	0.70	V
Line Regulation	6V≤V_{IN}≤26V		4	50	mV
Load Regulation	1mA≤I_{OUT_2}≤10mA		10	50	mV
Quiescent Current	I_{OUT_2}≤10mA,V_{OUT_1} OFF		2	3	mA
Ripple Rejection	f=120Hz		66		dB
Current Limit		25	70		mA
Output Noise Voltage	10Hz-100kHz		300		µV
Long Term Stability			50		mV/khr
Output Impedance	10mA_{DC} and 1mA_{rms}, 100Hz-10kHz		1		Ω
■ ENABLE Function (ENABLE)					
Input ENABLE Threshold	V_{OUT_1} Off			0.8	V
	V_{OUT_1} On	2.0			V
Input ENABLE Current	0V≤V_{IN}≤26V	-10		10	µA

Package Pin Description

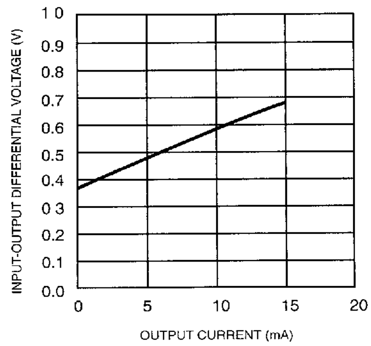
PACKAGE PIN # 5 Lead TO-220	PIN SYMBOL	FUNCTION
1	V_{IN}	Supply voltage to IC, usually direct from battery.
2	V_{OUT_1}	Regulated output voltage 10V, 500mA (typ).
3	Gnd	Ground connection.
4	ENABLE	CMOS compatible input pin; switches V_{OUT_1}. When ENABLE is high, V_{OUT_1} is active.
5	V_{OUT_2}	Standby output 5V, 10mA(typ); always on

Typical Performance Characteristics

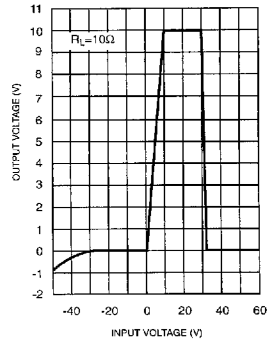
Dropout Voltage vs. Output Current



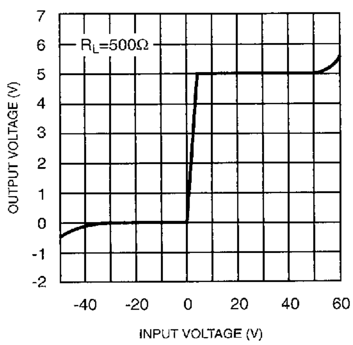
Standby Dropout Voltage vs. Standby Output Current



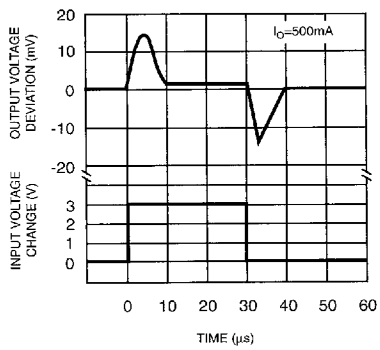
Output Voltage vs. Input Voltage



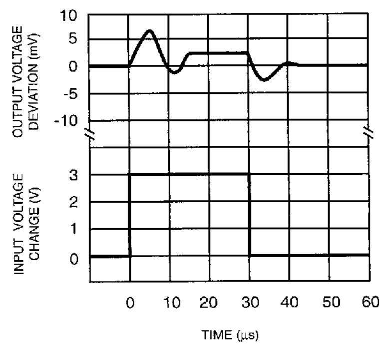
Standby Output Voltage vs. Input Voltage



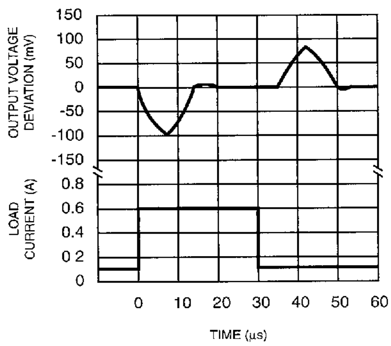
Line Transient Response (V_{OUT_1})



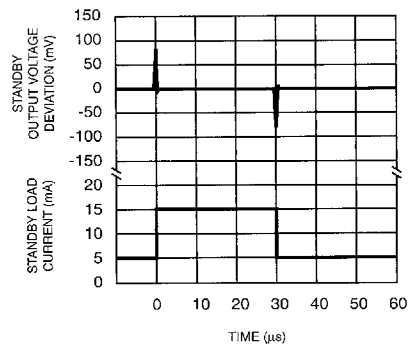
Line Transient Response (V_{OUT_2})



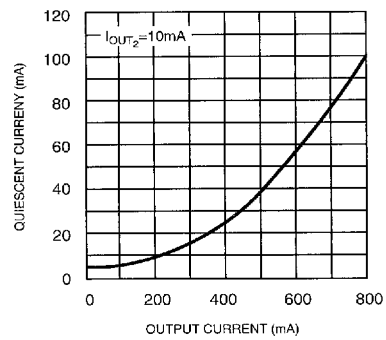
Load Transient Response (V_{OUT_1})



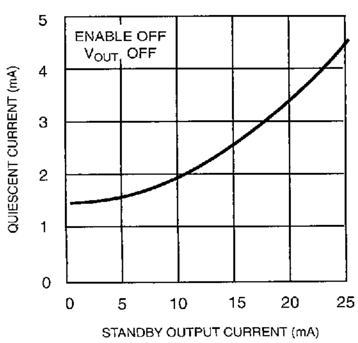
Load Transient Response (V_{OUT_2})



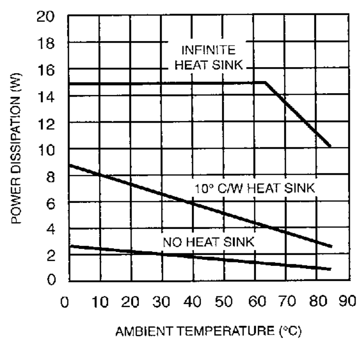
Quiescent Current vs. Output Current



Quiescent Current vs. Standby Output Current



Maximum Power Dissipation (TO-220)



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Definition of Terms

Current Limit: Peak current that can be delivered to the output.

Dropout Voltage: The input-output voltage differential at which the circuit ceases to regulate against further reduction in input voltage. Measured when the output voltage has dropped 100mV from the nominal value obtained at 14V input, dropout voltage is dependent upon load current and junction temperature.

Input Output Differential: The voltage difference between the unregulated input voltage and the regulated output voltage for which the regulator will operate.

Input Voltage: The DC voltage applied to the input terminals with respect to ground.

Line Regulation: The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

Load Regulation: The change in output voltage for a change in load current at constant chip temperature.

Long Term Stability: Output voltage stability under accelerated life-test conditions after 1000 hours with maximum rated voltage and junction temperature.

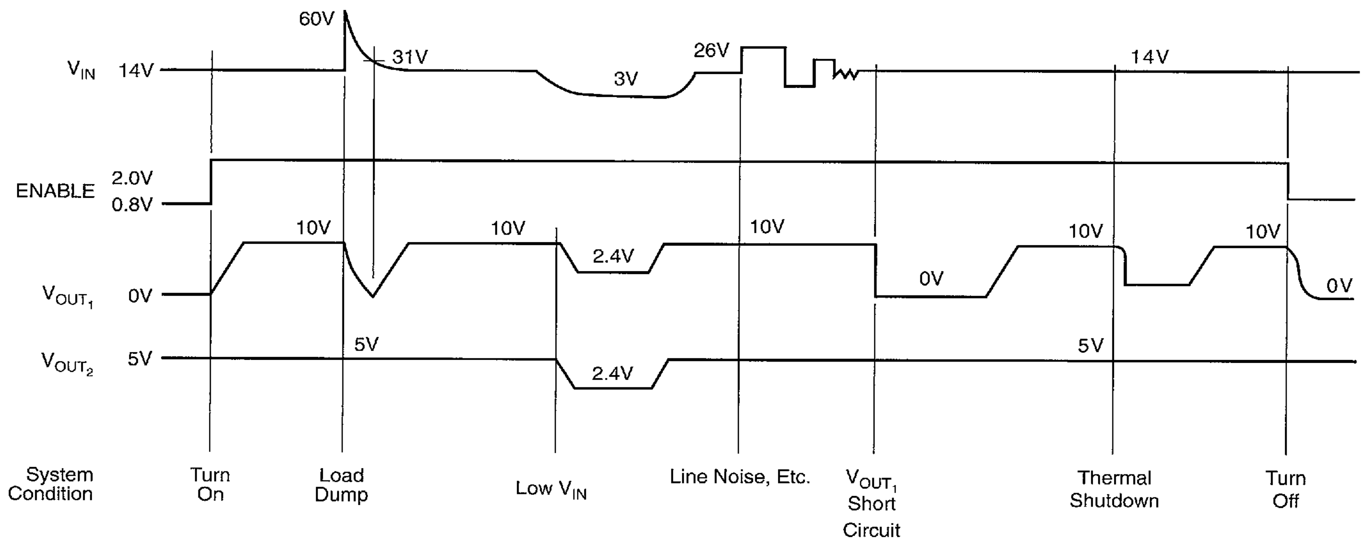
Output Noise Voltage: The rms AC voltage at the output, with constant load and no input ripple, measured over a specified frequency range.

Quiescent Current: The part of the positive input current that does not contribute to the positive load current. i.e., the regulator ground lead current.

Ripple Rejection: The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

Temperature Stability of V_{OUT}: The percentage change in output voltage for a thermal variation from room temperature to either temperature extreme.

Typical Circuit Waveform



Application Notes

External Capacitors

The CS-8145 output capacitors are required for stability. Without them, the regulator outputs will oscillate. The capacitor values shown in the Test and Application Circuit are the minimum recommended values. Actual size and type may vary depending upon the application load and temperature range. Capacitor effective series resistance (ESR) is also a factor in the IC stability. Worst-case is determined at the minimum ambient temperature and maximum load expected.

Output capacitors can be increased in size to any desired value above the minimum. One possible purpose of this would be to maintain the output voltages during brief conditions of negative input transients that might be characteristic of a particular system.

Capacitors must also be rated at all ambient temperatures expected in the system. To maintain regulator stability down to -40°C, capacitors rated at that temperature must be used.

Standby Output

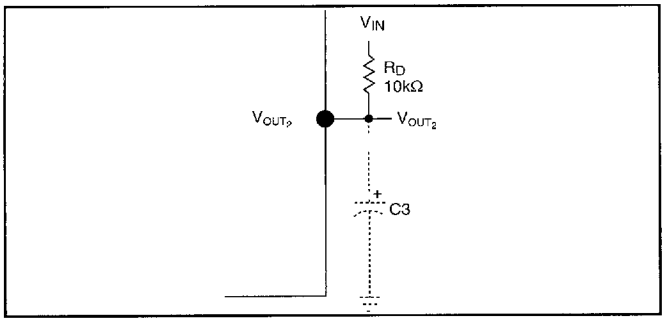
The CS-8145 differs from most fixed voltage regulators in that it is equipped with two regulator outputs instead on one. The additional output is intended for use in systems requiring standby memory circuits. While the high current regulator output can be controlled with the ENABLE pin described below, the standby output remains on under all conditions as long as sufficient input voltage is

Application Notes

applied to the IC. Thus, memory and other circuits powered by this output remain unaffected by positive line transients, thermal shutdown, etc.

The standby regulator circuit is designed so that the quiescent current to the IC is very low (<2mA) when the other regulator output is off.

In applications where the standby output is not needed, it may be disabled by connecting a resistor from the standby output to the supply voltage. This eliminates the need for a capacitor on the output to prevent unwanted oscillations. The value of the resistor depends upon the minimum input voltage expected for a given system. Since the standby output is shunted with an internal 6.0V Zener, the current through the external resistor should be sufficient to bias V_{OUT_2} up to this point. Approximately 60µA will suffice, resulting in a 10kΩ external resistor for most applications.



C_3 is no longer needed when V_{OUT_2} is disabled

High Current Output

Unlike the standby regulated output, which must remain on whenever possible, the high current regulated output is fault protected against overvoltage and also incorporates thermal shutdown. If the input voltage rises above approximately 30V (e.g., load dump), this output will automatically shutdown. This protects the internal circuitry and enables the IC to survive higher voltage transients than would otherwise be expected. Thermal shutdown is effective against die overheating since the high current output is the dominant source of power dissipation in the IC.

External Capacitors

The ENABLE function Controls V_{OUT_1} When ENABLE is high (5V), V_{OUT_1} is on. When ENABLE is low, V_{OUT_1} is off.

Thermal Management

The CS-8145 operates up to a junction temperature (T_J) of 150°C. However, the IC's worst-case operating conditions determine the maximum ambient temperature for a given application. The maximum ambient temperature may be calculated by the following equation:

$$T_A = T_J - [(V_{IN} - V_{O1})I_{O1} + (V_{IN} - V_{O2})I_{O2} + V_{IN}I_Q]\, R_{JA}$$

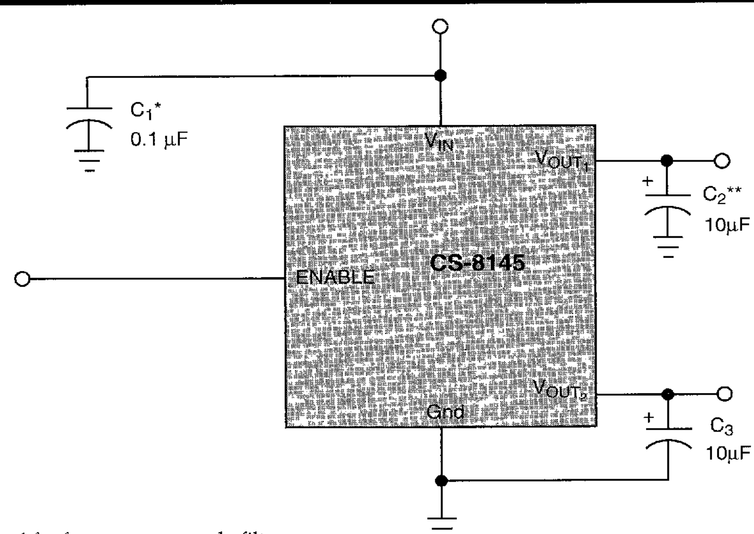
where
T_J = 150°C
V_{IN} = Maximum Input Voltage
V_{O1} = 10V
I_{O1} = 10V Maximum Output Current
V_{O2} = 5V
I_{O2} = 5V Maximum Output Current
I_Q = IC's Quiescent current at Maximum Output Currents

The TO-220 thermal resistances are listed under the package thermal data heading. When using a heat sink:

$$R_{JA} = R_{JC} + R_{CA} = 3.5°C/W + R_{CA}$$

where R_{CA} = Heat Sink Thermal Resistance

Test & Application Circuit

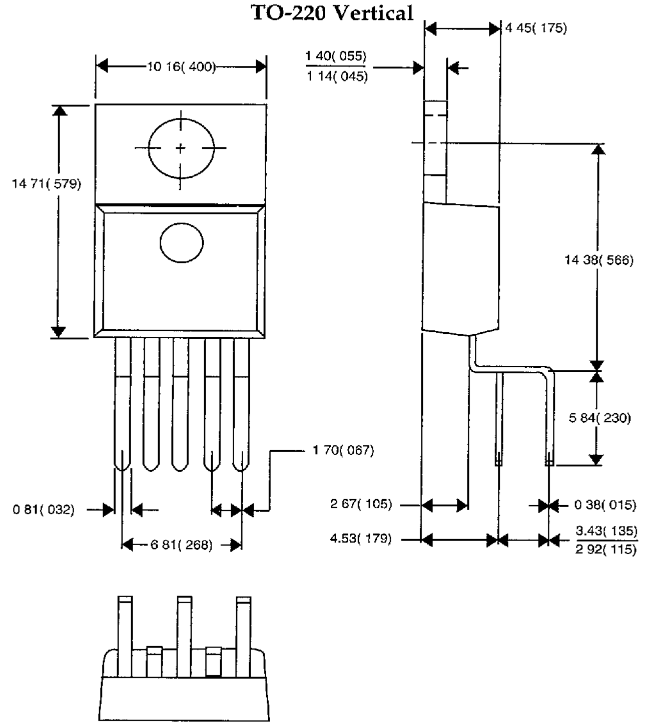


* C1 required if regulator is located far from power supply filter.
** C2 required for stability...value may be increased. Capacitor must operate at minimum temperature expected.

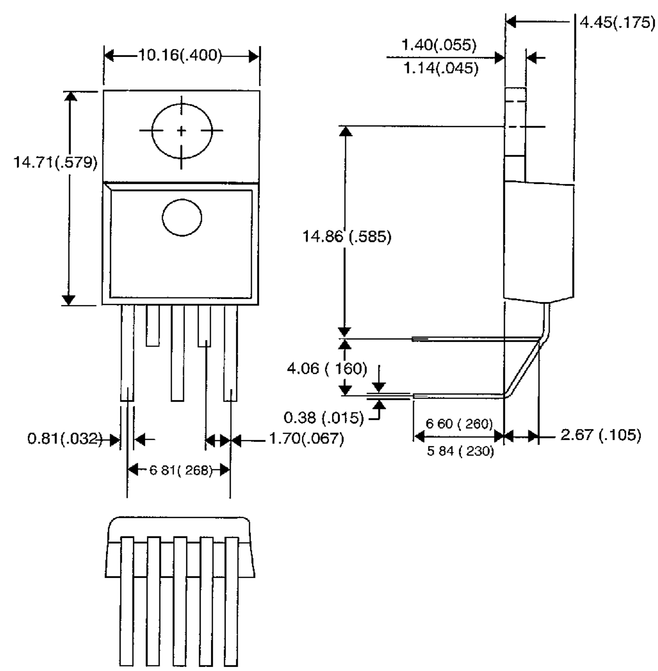
Package Specification

PACKAGE DIMENSIONS IN MM(INCHES)

TO-220 Vertical



TO-220 Horizontal



PACKAGE THERMAL DATA

Thermal Data		TO-220	
$R_{\Theta JC}$	typ	3.5	°C/W
$R_{\Theta JA}$	typ	50	°C/W

Ordering Information

Part Number	Description
CS-8145T5	TO-220 Straight
CS-8145TV5	TO-220 Vertical
CS-8145TH5	TO-220 Horizontal

Preliminary

This product is in the preproduction stages of the design process. The data sheet contains preliminary data. CSC reserves the right to make changes to the specifications without notice. Please contact CSC for the latest available information.

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