

RC4195

Fixed $\pm 15V$ Dual Tracking Voltage Regulator

Features

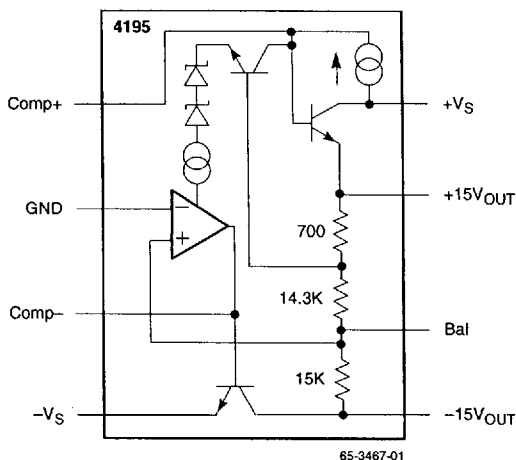
- $\pm 15V$ operational amplifier power at reduced cost and component density
- Thermal shutdown at $T_J = +175^\circ C$ in addition to short circuit protection
- Output currents to 100 mA
- May be used as single output regulator with up to +50V output
- Available in TO-66, TO-99 and 8-lead mini-DIP

Description

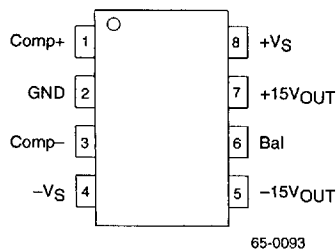
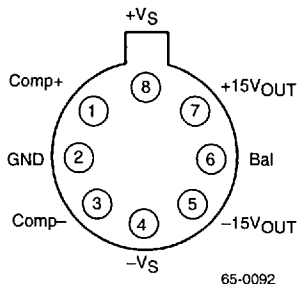
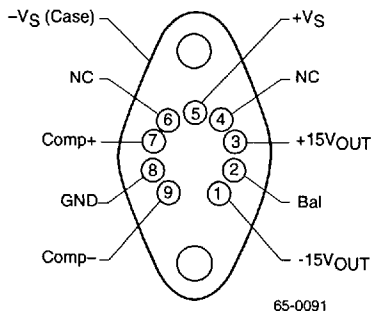
The RM/RC4195 is a dual polarity tracking regulator designed to provide balanced positive and negative 15V output voltages at currents up to 100mA. This device is designed for local "on-card" regulation, eliminating distribution problems associated with single point regulation. The regulator is intended for ease of application. Only two external components are required for operation (two 10 μF bypass capacitors).

The device is available in four package types to accommodate various applications requiring economy, high power, dissipation, and reduced component density.

Block Diagram



Pin Assignments



Absolute Maximum Ratings

(beyond which the device may be damaged)¹

| Parameter | | Min | Typ | Max | Units |
|--|------------|-----|-------|----------|-------|
| Supply Voltage ($\pm V_S$) to Ground | | | | ± 30 | V |
| Load Current | PDIP/TO-99 | | | 150 | mA |
| | TO-66 | | | 100 | mA |
| PdTA < 50°C | PDIP | | | 468 | mW |
| | TO-99 | | | 658 | mW |
| | TO-66 | | | 2381 | mW |
| Junction Temperature | PDIP | | | 125 | °C |
| | TO-99 | | | 175 | °C |
| | TO-66 | | | 150 | °C |
| Storage Temperature | | -65 | | 150 | °C |
| Operating Temperature (Tj) | RC4195 | 0 | | 70 | °C |
| | RM4195 | -55 | | 125 | °C |
| Lead Soldering Temperature (60 sec) | | | | 300 | °C |
| For TA > 50°C Derate at | PDIP | | 6.25 | | mW/°C |
| | TO-99 | | 5.26 | | mW/°C |
| | TO-66 | | 23.81 | | mW/°C |

Note:

1. Functional operation under any of these conditions is NOT implied. Performance and reliability are guaranteed only if Operating Conditions are not exceeded.

Operating Conditions

| Parameter | | Min | Typ | Max | Units |
|---------------|--------------------|-------|-----|-----|-------|
| θ_{JC} | Thermal resistance | TO-99 | 50 | | °C/W |
| | | TO-66 | 7 | | °C/W |
| θ_{JA} | Thermal resistance | PDIP | 160 | | °C/W |
| | | TO-99 | 190 | | °C/W |
| | | TO-66 | 42 | | °C/W |

Electrical Characteristics

($I_L = \pm 1\text{mA}$; $V_S = \pm 20\text{V}$, $C_L = 10\mu\text{F}$; RM4195: $-55^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$; RC4195: $0^\circ\text{C} \leq T_j \leq +70^\circ\text{C}$ unless otherwise specified)¹

| Parameters | Test Conditions | Min | Typ | Max | Units |
|---------------------------------------|---|----------|-----------|-----------|---------------------|
| Line Regulation | $V_S = \pm 18\text{V to } \pm 30\text{V}$ | | 2 | 20 | mV |
| Load Regulation | $I_L = 1\text{mA to } 100\text{mA}$ | | 5 | 30 | mV |
| Output Voltage Drift With Temperature | | | 0.005 | 0.015 | %/ $^\circ\text{C}$ |
| Supply Current | $V_S = \pm 30\text{V}$, $I_L = 0\text{ mA}$ | | ± 1.5 | ± 4.0 | mA |
| Supply Voltage | | ± 18 | | ± 30 | V |
| Output Voltage | $T_j = +25^\circ\text{C}$ | 14.5 | 15.0 | 15.5 | V |
| Output Voltage Tracking | | | ± 50 | ± 300 | mV |
| Ripple Rejection | $F = 120\text{ Hz}$, $T_A = +25^\circ\text{C}$ | | 75 | | dB |
| Input-Output Voltage Differential | $I_L = 50\text{ mA}$ | 3.0 | | | V |
| Short Circuit Current | $T_j = +25^\circ\text{C}$ | | 220 | | mA |
| Output Noise Voltage | $T_j = +25^\circ\text{C}$, $F = 100\text{Hz to } 120\text{ kHz}$ | | 60 | | μVRMS |
| Internal Thermal Shutdown | | | 175 | | $^\circ\text{C}$ |

Note:

1. The specifications above apply for the given junction temperatures since pulse test conditions are used.

Typical Performance Characteristics

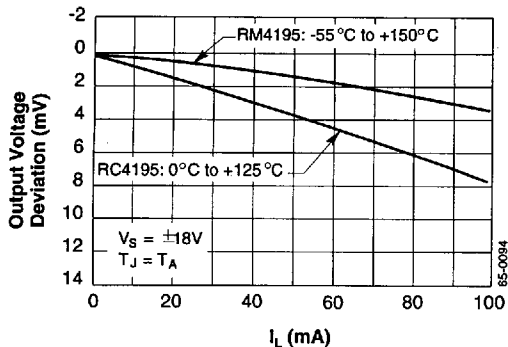


Figure 1. Output Load Regulation

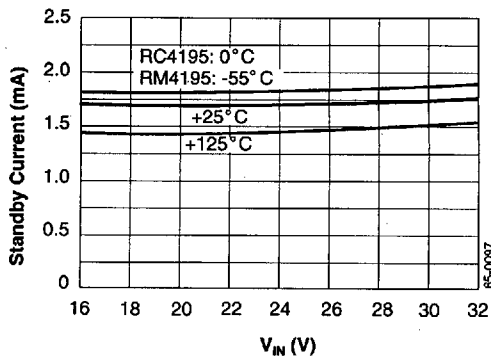


Figure 2. Standby Current Drain

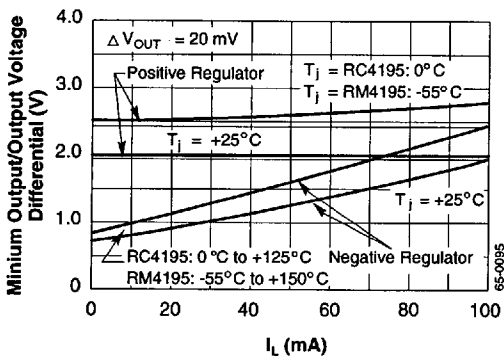


Figure 3. Regulator Dropout Voltage

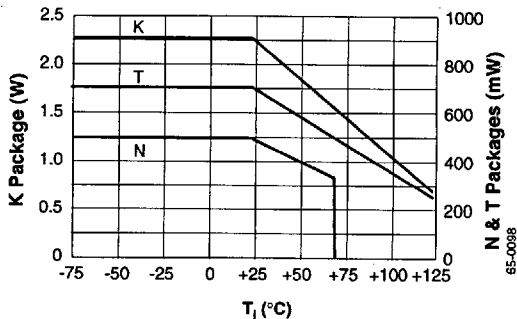


Figure 4. Power Dissipation

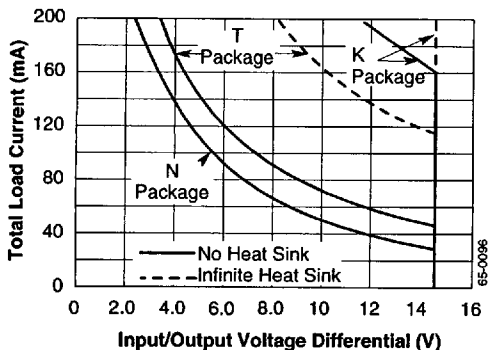


Figure 5. Maximum Current Capability

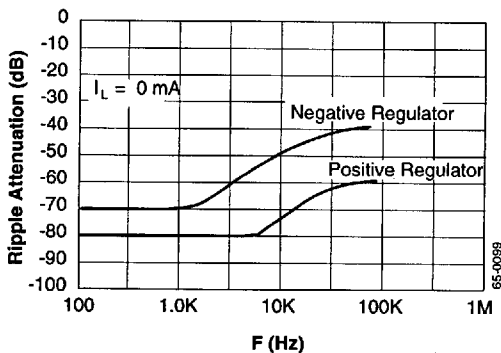


Figure 6. Ripple Rejection

Typical Applications

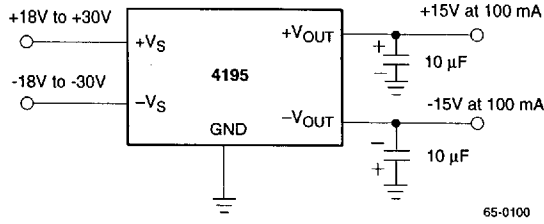


Figure 7. Balanced Output ($V_{OUT} = \pm 15V$)

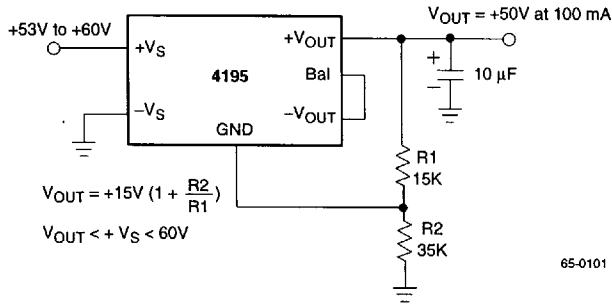


Figure 8. Positive Single Supply ($+15V < V_{OUT} < +50V$)

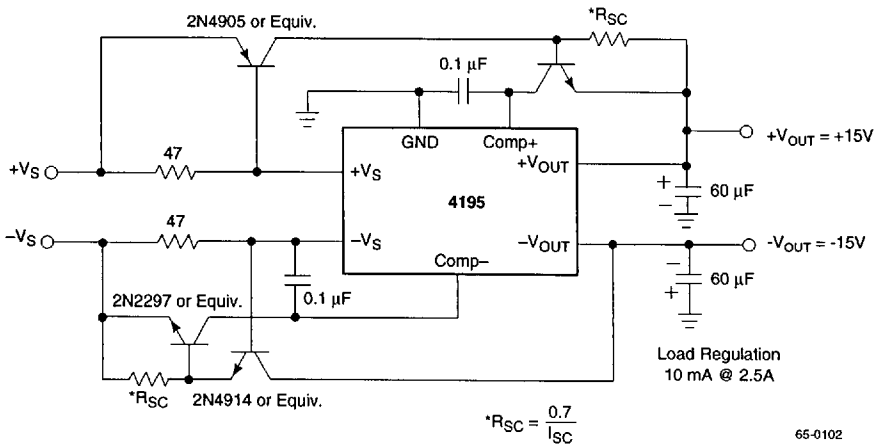


Figure 9. High Output Current

Brownout Protection

The RC4195 is one of the most easily applied and trouble-free monolithic ICs available. When used within the data sheet ratings (package power dissipation, maximum output current, minimum and maximum input voltages) it provides the most cost-effective source of regulated $\pm 15V$ for powering linear ICs.

Sometimes occasions arise in which the RC4195 ratings must be exceeded. One example is the "brownout". During a brownout, line voltages may be reduced to as low as 75 VRMS, causing the input voltage to the RC4195 to drop below the minimum dropout voltage. When this happens, the negative output voltage can go to positive. The maximum amount of current available is approximately 5 mA.

In general this is not enough current to damage most ICs which the RC4195 might be supplying, but it is a potentially destructive condition. Fortunately, it is easy to protect against. As shown in the typical application circuit, a diode, D, can be connected to the negative output.

If a small signal silicon diode is used, it will clamp the negative output voltage at about +0.55V. A Schottky barrier or germanium device would clamp the voltage at about +0.3V. Another cure which will keep the negative output negative all times is the 1 m Ω resistor connected between the +15V output and the Comp- terminal. this resistor will then supply drive to the negative output transistor, causing it to saturate to -1V during the brownout.

Heatsinking

When operating these devices near their extremes of load current, ambient temperature and input-output differential, consideration of package dissipation becomes important to

avoid thermal shutdown at 175°C. The RC4195 has this feature to prevent damage to the device. It typically starts affecting load regulation approximately 2°C below 175°C. To avoid shutdown, some form of heatsinking should be used or one of the above operating conditions would need to be derated.*

The following is the basic equation for junction temperature:

$$T_J = T_A + P_D \theta_{J-A}$$

Equation 1

where

T_J = junction temperature (°C)

T_A = ambient air temperature (°C)

P_D = power dissipated by device (W)

θ_{J-A} = thermal resistance from junction to ambient air (°C/W)

The power dissipated by the voltage regulator can be detailed as follows:

$$P_D = (V_{IN} - V_{OUT}) \times I_O + V_{IN} \times I_Q$$

Equation 2

where

V_{IN} = input voltage

V_{OUT} = regulated output voltage

I_O = load current

I_Q = quiescent current drain

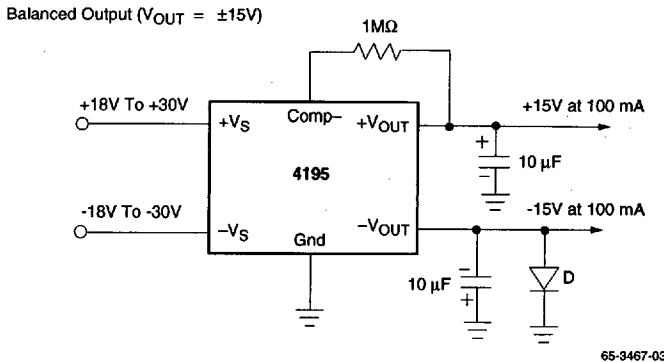


Figure 10. Typical Application Circuit

*In allowing for process deviations, the user should work with a maximum allowable function temperature of 150°C.

**The current drain will increase by 50µA/V_{OUT} on positive side and 100µA/V_{OUT} on negative side

Let's look at an application where a user is trying to determine whether the RC4195 in a high temperature environment will need a heatsink.

Given:

$$T_J \text{ at thermal shutdown} = 150^\circ\text{C}$$

$$T_A = 125^\circ\text{C}$$

$$\theta_{J-A} = 41.6^\circ\text{C/W, K (TO-66) pkg.}$$

$$V_{IN} = 40\text{V}$$

$$V_{OUT} = 30\text{V}$$

$$I_Q = 1 \text{ mA} + 75 \mu\text{A}/V_{OUT} \times 30\text{V} \\ = 3.25 \text{ mA}^{**}$$

$$\theta_{J-A} = \frac{T_J - T_A}{P_D}$$

$$P_D = \frac{T_J - T_A}{\theta_{J-A}}$$

$$= (V_{IN} - V_{OUT}) \times I_O + V_{IN} \times I_Q$$

Solve for I_O ,

$$I_O = \frac{T_J - T_A}{\theta_{J-A} (V_{IN} - V_{OUT})} - \frac{V_{IN} \times I_Q}{(V_{IN} - V_{OUT})}$$

$$I_O = \frac{150^\circ\text{C} - 125^\circ\text{C}}{41.6^\circ\text{C/W} \times 10\text{V}} - \frac{40 \times 3.25 \times 10^{-3}}{10}$$

$$= 60 \text{ mA} - 13 \text{ mA} - 47 \text{ mA}$$

If this supply current does not provide at least a 10% margin under worst case load conditions, heatsinking should be employed. If reliability is of prime importance, the multiple regulator approach should be considered.

In Equation 1, θ_{J-A} can be broken into the following components:

$$\theta_{J-A} = \theta_{J-C} + \theta_{C-S} + \theta_{S-A}$$

where

θ_{J-C} = junction-to-case thermal resistance

θ_{C-S} = case-to-heatsink thermal resistance

θ_{S-A} = heatsink-to-ambient thermal resistance

In the above example, let's say that the user's load current is 200 mA and he wants to calculate the combined θ_{C-S} and θ_{S-A} he needs:

Given: $I_O = 200 \text{ mA}$,

$$\theta_{J-A} = \frac{T_J - T_A}{(V_{IN} - V_{OUT}) \times I_O + V_{IN} \times I_Q} \\ = \frac{50^\circ\text{C} - 125^\circ\text{C}}{10\text{V} \times 200\text{mA} + 40 \times 3.25 \times 10^{-3}}$$

$$= 11.75^\circ\text{C/W}$$

Given $\theta_{J-C} = 7.15^\circ\text{C/W}$ for the 4194 in the K package,

$$\theta_{C-S} + \theta_{S-A} = 11.75^\circ\text{C/W} - 7.15^\circ\text{C/W} \\ = 4.6^\circ\text{C/W}$$

When using heatsink compound with a metal-to-metal interface, a typical $\theta_{C-S} = 0.5^\circ\text{C/W}$ for the K package. The remaining θ_{S-A} of approximately 4°C/W is a large enough thermal resistance to be easily provided by a number of heatsinks currently available. Table 1 is a brief selection guide to heatsink manufacturers.

Table 1. Commercial Heatsink Selection Guide

No attempt has been made to provide a complete list of all heatsink manufacturers. This list is only representative.

| θ_{S-A}^* ($^{\circ}\text{C/W}$) | Manufacturer/Series or Part Number |
|---|---|
| TO-66 Package | |
| 0.31 – 1.0 | Thermalloy — 6441, 6443, 6450, 6470, 6560, 6590, 6660, 6690 |
| 1.0 – 3.0 | Wakefield — 641 |
| | Thermalloy — 6123, 6135, 6169, 6306, 6401, 6403, 6421, 6423, 6427, 6442, 6463, 6500 |
| 3.0 – 5.0 | Wakefield — 621, 623 |
| | Thermalloy — 6606, 6129, 6141, 6303 |
| | IERC — HP |
| | Staver — V3-3-2 |
| 5.0 – 7.0 | Wakefield — 690 |
| | Thermalloy — 6002, 6003, 6004, 6005, 6052, 6053, 6054, 6176, 6301 |
| | IERC — LB |
| | Staver — V3-5-2 |
| 7.0 – 10.0 | Wakefield — 672 |
| | Thermalloy — 6001, 6016, 6051, 6105, 6601 |
| | IERC — LA, uP |
| | Staver — V1-3, V1-5, V3-3, V3-5, V3-7 |
| 10.0 – 25.0 | Thermalloy — 6-13, 6014, 6015, 6103, 6104, 6105, 6117 |
| TO-99 Package | |
| 12.0 – 20.0 | Wakefield — 260 |
| | Thermalloy — 1101, 1103 |
| | Staver — V3A-5 |
| 20.0 – 30.0 | Wakefield — 209 |
| | Thermalloy — 1116, 1121, 1123, 1130, 1131, 1132, 2227, 3005 |
| | IERC — LP |
| | Staver — F5-5 |
| 3.0 – 50.0 | Wakefield — 207 |
| | Thermalloy — 2212, 2215, 225, 2228, 2259, 2263, 2264 |
| Dual In-line Package | |
| 20 | Thermalloy — 6007 |
| 30 | Thermalloy — 6010 |
| 32 | Thermalloy — 6011 |
| 34 | Thermalloy — 6012 |
| 45 | IERC — LI |
| 60 | Wakefield — 650, 651 |

Staver Co., Inc.: 41-51 N Saxon Ave., Bay Shore, NY 11706

IERC: 135 W Magnolia Blvd., Burbank, CA 91502

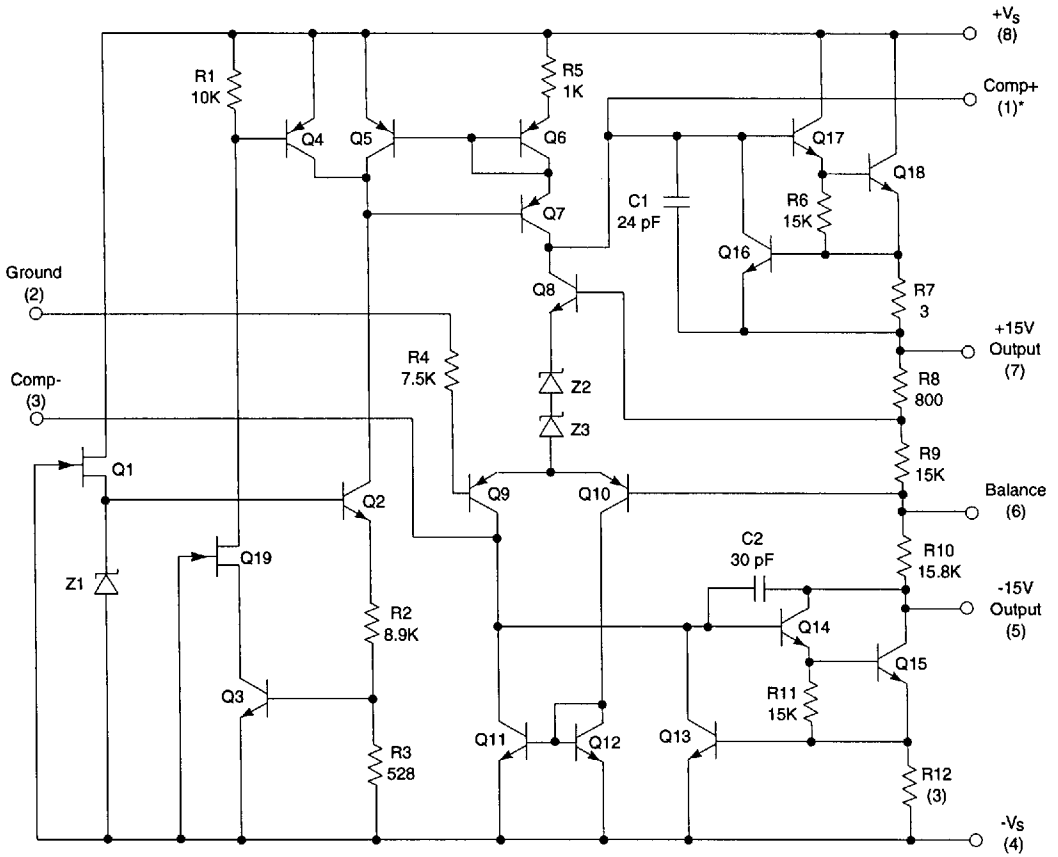
Thermalloy: P.O. Box 34829, 2021 W Valley View Ln., Dallas, TX

Wakefield Engin Ind: Wakefield, MA 01880

* All values are typical as given by manufacturer or as determined from characteristic curves supplied by manufacturer.

Simplified Schematic Diagram

ANALOG



*Pin numbers are for 8-pin packages.

65-0090

Ordering Information

| Product Number | Temperature Range | Screening | Package |
|----------------|-------------------|------------|-----------------------|
| RC4195N | 0° to +70°C | Commercial | 8 Pin Plastic DIP |
| RC4195T | 0° to +70°C | Commercial | 8 Pin TO-99 Metal Can |
| RC4195K | 0° to +70°C | Commercial | 9 Pin TO-66 Metal Can |
| RM4195T | -55°C to +125°C | Commercial | 8 Pin TO-99 Metal Can |
| RM4195T/883B | -55°C to +125°C | Military | 8 Pin TO-99 Metal Can |
| RM4195K | -55°C to +125°C | Commercial | 9 Pin TO-66 Metal Can |

Note:

1. /883B suffix denotes MIL-STD-883, Par. 1.2.1 compliant device.