

# AN5441S

## Deflection distortion correction IC

### ■ Overview

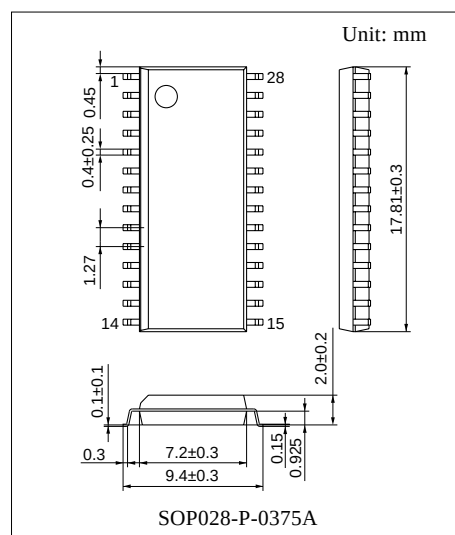
The AN5441S is a distortion correction processing IC for deflection system of color televisions and wide screen televisions.

### ■ Features

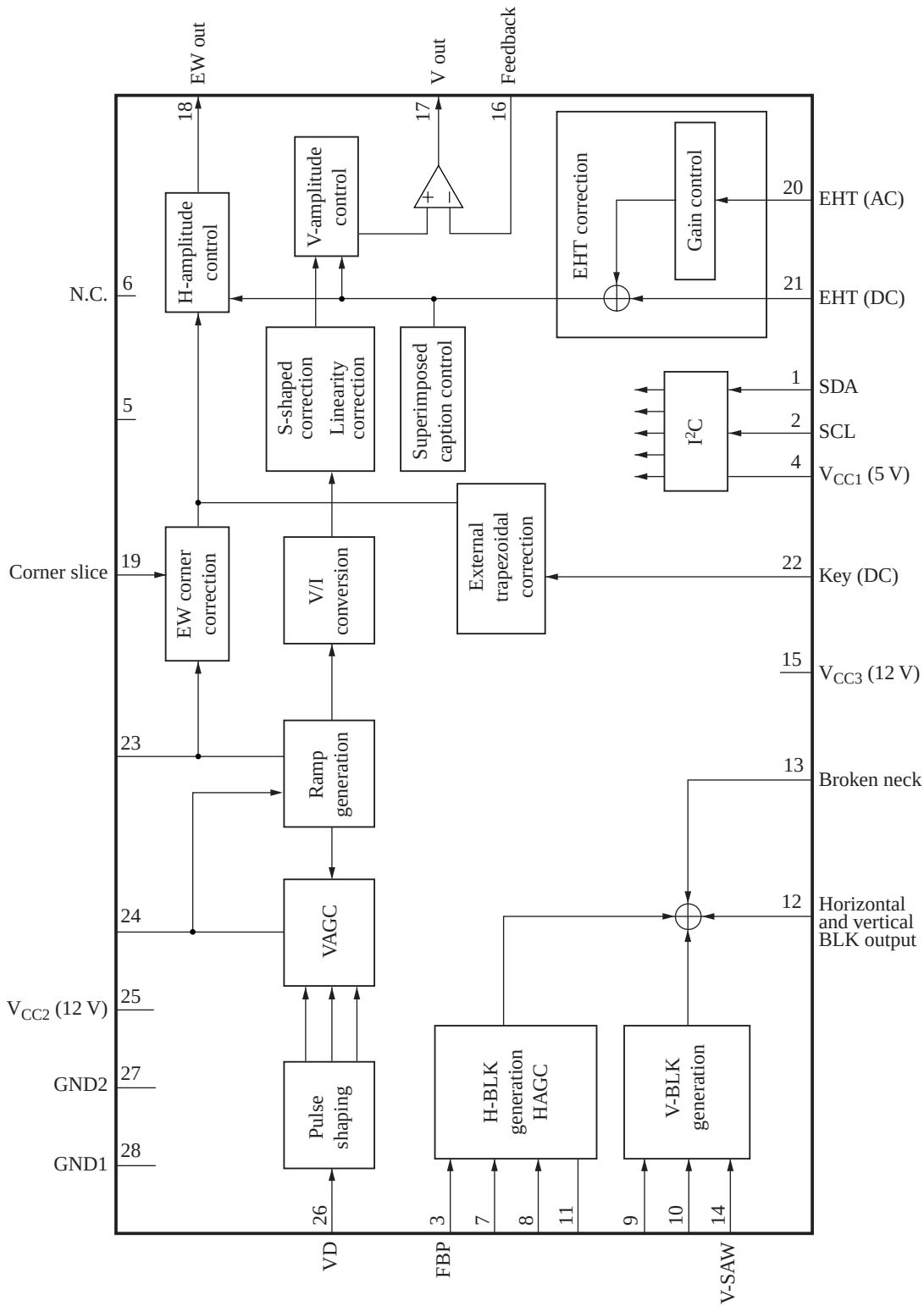
- Distortion correcting functions
  - Vertical amplitude
  - Vertical linearity
  - Vertical S-shape
  - Vertical position
  - Vertical EHT
  - Horizontal amplitude
  - EW parabola
  - Trapezoidal
  - Upper/lower EW corner
  - Horizontal EHT
- Built-in horizontal and vertical blanking pulse generation circuit
- Supports I<sup>2</sup>C bus control

### ■ Applications

- Color televisions and wide screen televisions



■ Block Diagram



## ■ Pin Descriptions

| Pin No. | Description                        | Pin No. | Description                     |
|---------|------------------------------------|---------|---------------------------------|
| 1       | I <sup>2</sup> C SDA input         | 15      | V <sub>CC3</sub> (12 V)         |
| 2       | I <sup>2</sup> C SCL input         | 16      | Vertical feedback input         |
| 3       | Horizontal FBP input               | 17      | Vertical pre-drive output       |
| 4       | V <sub>CC1</sub> (5 V)             | 18      | EW output                       |
| 5       | Test pin                           | 19      | Corner slice voltage            |
| 6       | N.C.                               | 20      | EHT-AC input                    |
| 7       | H-BLK high-level slice voltage     | 21      | EHT-DC input                    |
| 8       | H-BLK low-level slice voltage      | 22      | Control for keystone correction |
| 9       | V-BLK high-level slice voltage     | 23      | Capacitor for ramp generation   |
| 10      | V-BLK low-level slice voltage      | 24      | Capacitor for V-AGC             |
| 11      | Capacitor for H-AGC                | 25      | V <sub>CC2</sub> (12 V)         |
| 12      | Horizontal and vertical BLK output | 26      | VD pulse input                  |
| 13      | Broken neck detection              | 27      | GND2                            |
| 14      | V-BLK sawtooth input               | 28      | GND1                            |

## ■ Absolute Maximum Ratings

| Parameter                        | Symbol           |                                     | Rating      | Unit |
|----------------------------------|------------------|-------------------------------------|-------------|------|
| Supply voltage                   | V <sub>CC</sub>  | V <sub>CC1</sub>                    | 5.6         | V    |
|                                  |                  | V <sub>CC2</sub> , V <sub>CC3</sub> | 13.4        |      |
| Supply current                   | I <sub>CC</sub>  | I <sub>CC1</sub>                    | 24.5        | mA   |
|                                  |                  | I <sub>CC2</sub>                    | 24.0        |      |
|                                  |                  | I <sub>CC3</sub>                    | 3.2         |      |
| Power dissipation *2             | P <sub>D</sub>   |                                     | 449         | mW   |
| Operating ambient temperature *2 | T <sub>opr</sub> |                                     | −20 to +70  | °C   |
| Storage temperature *1           | T <sub>stg</sub> |                                     | −55 to +150 | °C   |

Note) \*1 : Except for the operating ambient temperature and storage temperature, all ratings are for T<sub>a</sub> = 25°C.

\*2 : The power dissipation shown is the value for T<sub>a</sub> = 70°C.

## ■ Recommended Operating Range

| Parameter      | Symbol           | Range        | Unit |
|----------------|------------------|--------------|------|
| Supply voltage | V <sub>CC1</sub> | 4.5 to 5.5   | V    |
|                | V <sub>CC2</sub> | 10.8 to 13.2 |      |
|                | V <sub>CC3</sub> | 10.8 to 13.2 |      |

■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$

| Parameter                                             | Symbol                                        | Conditions                                                                                 | Min   | Typ   | Max   | Unit          |
|-------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------|-------|-------|-------|---------------|
| Circuit current $I_{CC1}$                             | $I_4$                                         | $V_{CC1} = 5\text{ V}$ , $V_{CC2} = 12\text{ V}$ , $V_{CC3} = 12\text{ V}$                 | 11.7  | 17.0  | 20.2  | mA            |
| Circuit current $I_{CC2}$                             | $I_{25}$                                      | $V_{CC1} = 5\text{ V}$ , $V_{CC2} = 12\text{ V}$ , $V_{CC3} = 12\text{ V}$                 | 13.1  | 16.6  | 20.2  | mA            |
| Circuit current $I_{CC3}$                             | $I_{15}$                                      | $V_{CC1} = 5\text{ V}$ , $V_{CC2} = 12\text{ V}$ , $V_{CC3} = 12\text{ V}$                 | 1.8   | 2.1   | 2.3   | mA            |
| EHT-AC input pin voltage                              | $V_{20-27, 28}$                               | $V_{CC1} = 5\text{ V}$ , $V_{CC2} = 12\text{ V}$ , $V_{CC3} = 12\text{ V}$                 | 2.6   | 3.0   | 3.4   | V             |
| Vertical pull-in frequency 1                          | $f_{V1}$                                      | $f_V = 50\text{ Hz}$ input                                                                 | 45    | 50    | 55    | Hz            |
| Vertical pull-in frequency 2                          | $f_{V2}$                                      | $f_V = 60\text{ Hz}$ input                                                                 | 55    | 60    | 65    | Hz            |
| Typical vertical output amplitude                     | $e_{V(\text{typ})}$                           | typ.                                                                                       | 2.3   | 2.7   | 3.1   | V[p-p]        |
| Typical EW output amplitude                           | $e_{E(\text{typ})}$                           | typ.                                                                                       | 1.42  | 1.82  | 2.22  | V[p-p]        |
| Vertical BLK output pulse width                       | $t_{VB}$                                      | Wide                                                                                       | 3.3   | 4.8   | 6.2   | ms            |
| Horizontal BLK output pulse width 1                   | $t_{HB(1)}$                                   | Normal                                                                                     | 11.7  | 12.2  | 12.7  | $\mu\text{s}$ |
| Horizontal BLK output pulse width 2                   | $t_{HB(2)}$                                   | Wide                                                                                       | 37    | 39    | 41    | $\mu\text{s}$ |
| Vertical output amplitude change ratio (max.)         | $\frac{e_{V(\text{max})}}{e_{V(\text{typ})}}$ | V amplitude typ. $\rightarrow$ max. ratio                                                  | 42    | 48    | 54    | %             |
| Vertical output amplitude change ratio (min.)         | $\frac{e_{V(\text{min})}}{e_{V(\text{typ})}}$ | V amplitude typ. $\rightarrow$ min. ratio                                                  | -54   | -48   | -42   | %             |
| Vertical output S-shape change ratio 1                | $\Delta e_{VS1}$                              | Vertical S-shape min. $\rightarrow$ max. ratio                                             | -20   | -13   | -6    | %             |
| Vertical output S-shape change ratio 2                | $\Delta e_{VS2}$                              | Vertical S-shape min. $\rightarrow$ max. ratio<br>(change of V out 40% to 60% point)       | —     | 1.5   | 6.0   | %             |
| Vertical output (upper side) linearity change ratio 1 | $\Delta e_{VC1}$                              | Vertical linearity (upper side) typ. $\rightarrow$ max.                                    | 6     | 10    | 14    | %             |
| Vertical output (upper side) linearity change ratio 2 | $\Delta e_{VC2}$                              | Vertical linearity (upper side) typ. $\rightarrow$ max.                                    | -14   | -10   | -6    | %             |
| Vertical output position change amount (max.)         | $\Delta e_{VP(\text{max})}$                   | Vertical position typ. $\rightarrow$ max.                                                  | -1.0  | -0.8  | -0.6  | V             |
| Vertical output position change amount (min.)         | $\Delta e_{VP(\text{min})}$                   | Vertical position typ. $\rightarrow$ min.                                                  | 0.5   | 0.7   | 0.9   | V             |
| Vertical output (lower side) linearity change ratio 1 | —                                             | Vertical linearity (lower side) typ. $\rightarrow$ max.                                    | 8     | 12    | 16    | %             |
| Vertical output (lower side) linearity change ratio 2 | —                                             | Vertical linearity (lower side) typ. $\rightarrow$ min.                                    | -16   | -12   | -8    | %             |
| Vertical output EHT-DC change                         | $\Delta e_{VED}$                              | EHT-DC = 6 V,<br>vertical EHT, min. $\rightarrow$ max.                                     | -24.8 | -21.8 | -18.8 | %             |
| Vertical output EHT-AC change 1                       | $\Delta e_{VEA(1)}$                           | EHT-AC = 2V, VEHT: max.,<br>EHT gain, min. $\rightarrow$ max.                              | -16   | -12   | -8    | %             |
| Vertical output EHT-AC change 2                       | $\Delta e_{VEA(2)}$                           | EHT-AC = 4 V, VEHT: max.,<br>EHT gain, min. $\rightarrow$ max.                             | 9     | 13    | 17    | %             |
| Vertical output superimposed caption change 1         | $\Delta e_{VJ(1)}$                            | Vertical superimposed caption min. $\rightarrow$ max.                                      | -13   | -10   | -7    | %             |
| Vertical output superimposed caption change 2         | $\Delta e_{VJ(2)}$                            | Vertical superimposed caption min. $\rightarrow$ max., V amplitude typ. $\rightarrow$ min. | -15   | -11   | -7    | %             |

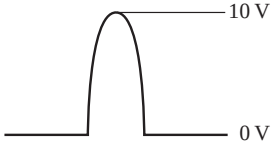
■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$  (continued)

| Parameter                                    | Symbol                 | Conditions                                                | Min  | Typ  | Max  | Unit   |
|----------------------------------------------|------------------------|-----------------------------------------------------------|------|------|------|--------|
| Vertical output amplitude (max.)             | $\Delta e_{V(\max)}$   | V amplitude max.                                          | 3.5  | 3.9  | 4.3  | V      |
| Vertical output amplitude (min.)             | $\Delta e_{V(\min)}$   | V amplitude min.                                          | 1.1  | 1.4  | 1.7  | V      |
| Vertical output center DC level              | $\Delta e_{VDC}$       | typ.                                                      | 4.5  | 4.9  | 5.3  | V      |
| EW output parabolic amplitude change (min.)  | $e_{E(\min)}$          | Parabolic amplitude min.                                  | 0    | 0.1  | 0.5  | V[p-p] |
| EW output parabolic amplitude change (max.)  | $e_{E(\max)}$          | Parabolic amplitude max.                                  | 2.5  | 3.5  | 4.5  | V[p-p] |
| EW output horizontal amplitude change (min.) | $e_{ED(\min)}$         | Horizontal amplitude min.                                 | 5.45 | 6.0  | 6.93 | V      |
| EW output horizontal amplitude change (max.) | $e_{ED(\max)}$         | Horizontal amplitude max.                                 | 0.7  | 2.0  | 2.6  | V      |
| EW output trapezoidal change (min.)          | $\Delta e_{ET(\min)}$  | Trapzoidal SW : On, trapezoidal typ. → min.               | 64   | 96   | 126  | %      |
| EW output trapezoidal change (max.)          | $\Delta e_{ET(\max)}$  | Trapzoidal SW : On, trapezoidal typ. → max.               | -130 | -100 | -68  | %      |
| EW output upper corner change (min.)         | $\Delta e_{ECT(\min)}$ | Upper corner min.                                         | -95  | -65  | -35  | %      |
| EW output upper corner change (max.)         | $\Delta e_{ECT(\max)}$ | Upper corner max.                                         | 30   | 60   | 90   | %      |
| EW output lower corner change (min.)         | $\Delta e_{ECB(\min)}$ | Lower corner min.                                         | -95  | -65  | -35  | %      |
| EW output lower corner change (max.)         | $\Delta e_{ECB(\max)}$ | Lower corner max.                                         | 25   | 55   | 85   | %      |
| EW output (bottom voltage) EHT-DC change     | $\Delta e_{EED}$       | EHT-DC: 6 V<br>Horizontal EHT min. → max.                 | 2.1  | 2.6  | 3.1  | V      |
| EW output (bottom voltage) EHT-AC change 1   | $\Delta e_{EEA(1)}$    | EHT-AC: 2 V, horizontal EHT: max., EHT gain min. → max.   | 1.2  | 1.4  | 1.6  | V      |
| EW output (bottom voltage) EHT-AC change 2   | $\Delta e_{EEA(2)}$    | EHT-AC: 4 V, horizontal EHT: max., EHT gain min. → max.   | -1.8 | -1.5 | -1.2 | V      |
| EW output (EW amplitude) KEY change 1 (min.) | $\Delta e_{EK(\min1)}$ | KEY = 2 V, trapezoidal SW: On, trapezoidal max. → min.    | 95   | 120  | 145  | %      |
| EW output (EW amplitude) KEY change 1 (max.) | $\Delta e_{EK(\max1)}$ | KEY = 3.2 V, trapezoidal SW: On, trapezoidal min. → max.  | -145 | -120 | -95  | %      |
| EW output parabolic DC level                 | $e_{EB}$               | typ.                                                      | 2.9  | 4.0  | 5.1  | V      |
| EW output (EW amplitude) KEY change 2 (min.) | $\Delta e_{EK(\min2)}$ | KEY = 2 V, trapezoidal SW: Off, trapezoidal max. → min.   | -145 | -120 | -95  | %      |
| EW output (EW amplitude) KEY change 2 (max.) | $\Delta e_{EK(\max2)}$ | KEY = 3.2 V, trapezoidal SW: Off, trapezoidal min. → max. | 95   | 120  | 145  | %      |
| EW output drive current 1                    | $I_{EW(1)}$            | Pin 18: 11 V                                              | 0.7  | 1.1  | 1.5  | mA     |
| V-AGC input and output current               | $I_{VAGC}$             |                                                           | 0.5  | 0.8  | 1.1  | mA     |
| H-AGC input and output current               | $I_{HAGC}$             |                                                           | 0.7  | 1.0  | 1.3  | mA     |

■ Electrical Characteristics at  $T_a = 25^\circ\text{C}$  (continued)

| Parameter                                                 | Symbol                 | Conditions                                          | Min  | Typ  | Max       | Unit          |
|-----------------------------------------------------------|------------------------|-----------------------------------------------------|------|------|-----------|---------------|
| Ramp discharge current                                    | $I_{RD}$               |                                                     | 6.7  | 8.9  | 11.1      | mA            |
| Ramp charge current 1                                     | $I_{RC(1)}$            | Pin 24: 1 V                                         | 40   | 45   | 52        | $\mu\text{A}$ |
| Vertical output at service SW                             | $V_{SSW}$              |                                                     | 4.55 | 4.95 | 5.35      | V             |
| Broken neck threshold voltage                             | $V_{Neck}$             | Service SW: Off                                     | 0.5  | 0.7  | 0.9       | V             |
| BLK output amplitude                                      | $V_{BO}$               |                                                     | 2.8  | 3.1  | 3.4       | V             |
| H-AGC voltage 1                                           | $V_{HAGC(1)}$          | HD: 14 kHz                                          | 2.6  | 3.25 | 3.9       | V             |
| H-AGC voltage 2                                           | $V_{HAGC(2)}$          | HD: 17 kHz                                          | 3.1  | 3.85 | 4.6       | V             |
| H-AGC pulse width                                         | $f_{HA}$               | 3 k $\Omega$ resistor between pin 11 and GND        | 1.5  | 2.2  | 3.0       | $\mu\text{s}$ |
| V-AGC pulse width                                         | $f_{VA}$               | 3 k $\Omega$ resistor between pin 24 and GND        | 75   | 110  | 150       | $\mu\text{s}$ |
| EW output drive current 2                                 | $I_{EW(2)}$            | Pin 18: 1 V                                         | -1.3 | -0.9 | -0.5      | mA            |
| Ramp charge current 2                                     | $I_{RC(2)}$            | Pin 24: 10 V                                        | 7    | 10   | 13        | $\mu\text{A}$ |
| H-AGC current $\Delta V$                                  | $V_{HAGC\Delta V}$     | HD: 17 kHz $\Delta V$                               | 0.2  | 0.6  | 1.1       | V             |
| VD input threshold value                                  | $V_{VD}$               |                                                     | 0.9  | 1.3  | 1.7       | V             |
| FBP input threshold value                                 | $V_{FBP}$              |                                                     | 0.5  | 0.7  | 0.9       | V             |
| High-level I <sup>2</sup> C SDA input                     | $V_{SDA(H)}$           |                                                     | 4.0  | —    | $V_{CC1}$ | V             |
| low-level I <sup>2</sup> C SDA input                      | $V_{SDA(L)}$           |                                                     | 0    | —    | 0.7       | V             |
| High-level I <sup>2</sup> C SCL input                     | $V_{SCL(H)}$           |                                                     | 4.0  | —    | $V_{CC1}$ | V             |
| Low-level I <sup>2</sup> C SCL input                      | $V_{SCL(L)}$           |                                                     | 0    | —    | 0.7       | V             |
| Maximum input allowable frequency                         | $f_{i\max}$            |                                                     | 100  | —    | —         | kHz           |
| Vertical output amplitude with supply voltage fluctuation | $\Delta e_{V-V_{CC}}$  | Difference of $V_{CC(\max)} - V_{CC(\min)}$         | 0    | 0.1  | 0.5       | V             |
| Vertical output with DC supply voltage fluctuation        | $\Delta e_{VD-V_{CC}}$ | Difference of $V_{CC(\max)} - V_{CC(\min)}$         | 0.5  | 1.0  | 1.5       | V             |
| EW output amplitude with supply voltage fluctuation       | $\Delta e_{E-V_{CC}}$  | Difference of $V_{CC(\max)} - V_{CC(\min)}$         | 0    | 0.1  | 0.5       | V             |
| EW output with DC supply voltage fluctuation              | $\Delta e_{ED-V_{CC}}$ | Difference of $V_{CC(\max)} - V_{CC(\min)}$         | 0.4  | 1.0  | 1.6       | V             |
| Sink current at ACK                                       | $I_{ACK}$              | Maximum value of pin 1 sink current at ACK          | —    | 2.5  | —         | mA            |
| 3-bit, 4-bit, 6-bit, 7-bit DAC DNLE                       | $L_{3, 4, 6, 7}$       | 1LSB = {data (max.) – data (00)}/<br>7, 15, 63, 127 | 0.1  | 1.0  | 1.9       | LSB/<br>step  |
| Vertical output drive current                             | $I_{V\text{ Out}}$     |                                                     | 7    | 11   | 15        | mA            |

■ Terminal Equivalent Circuits

| Pin No. | Equivalent circuit | Description                                                                                            | Voltage       |
|---------|--------------------|--------------------------------------------------------------------------------------------------------|---------------|
| 1       |                    | I <sup>2</sup> C bus data input pin:<br>Sink current: typ. 2.5 mA                                      | AC<br>(Pulse) |
| 2       |                    | I <sup>2</sup> C bus clock input pin                                                                   | AC<br>(Pulse) |
| 3       |                    | FBP input pin:<br> | AC<br>(Pulse) |
| 4       | —                  | V <sub>CC1</sub> (typ. 5 V):<br>For I <sup>2</sup> C circuit                                           | DC<br>5 V     |
| 5       |                    | Test pin:<br>Attach a capacitor (0.082 μF) for filter<br>to GND.                                       | DC<br>10.6 V  |

■ Terminal Equivalent Circuits (continued)

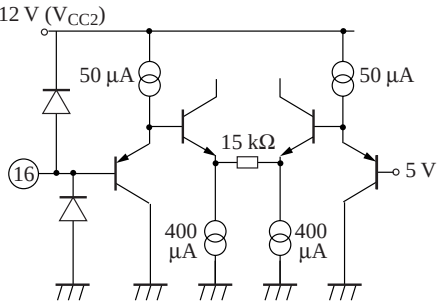
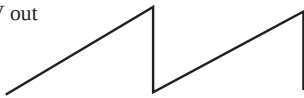
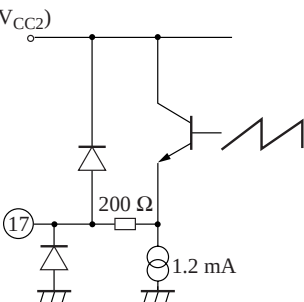
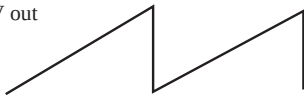
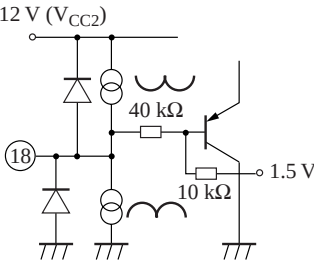
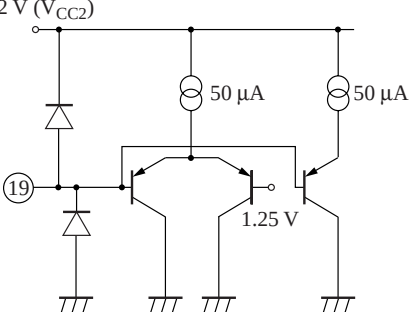
| Pin No. | Equivalent circuit | Description                                                          | Voltage                            |
|---------|--------------------|----------------------------------------------------------------------|------------------------------------|
| 6       | —                  | N.C                                                                  | N.C.                               |
| 7       |                    | <p>HBLK high-level slice voltage:</p>                                | <p>DC<br/>typ. 0 V<br/>to 4 V</p>  |
| 8       |                    | <p>HBLK low-level slice voltage:</p>                                 | <p>DC<br/>typ. 0 V<br/>to 4 V</p>  |
| 9       |                    | <p>VBLK high-level slice voltage:<br/>For I<sup>2</sup>C circuit</p> | <p>DC<br/>typ. 0 V<br/>to 10 V</p> |
| 10      |                    | <p>VBLK low-level slice voltage:</p>                                 | <p>DC<br/>0 V to<br/>10 V</p>      |



■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit                            | Description                                                                                                                                                                                                  | Voltage                |
|---------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 11      |                                               | H sawtooth AGC voltage pin                                                                                                                                                                                   | DC<br>1.5 V to<br>10 V |
| 12      |                                               | Blanking pulse output pin:<br>Horizontal/vertical BLK output pin<br>Blanking output high-level with neck<br>input low-level                                                                                  | AC<br>(Pulse)          |
| 13      |                                               | Broken neck detection pin:<br>Normal; High-level<br>(apply 1 V or more)<br>Abnormal; Low-level<br>(apply 0.4 V or more)<br>(Broken neck mode)<br>There is no broken neck operation<br>when service SW is on. | DC                     |
| 14      | Refer to pin 9 and pin 10 equivalent circuit. | Sawtooth input pin for V-BLK:<br><br>V-SAW<br>                                                                                                                                                               | AC                     |
| 15      | —                                             | V <sub>CC3</sub> (typ. 12 V):<br>For BLK pulse generation circuit.                                                                                                                                           | DC<br>12 V             |

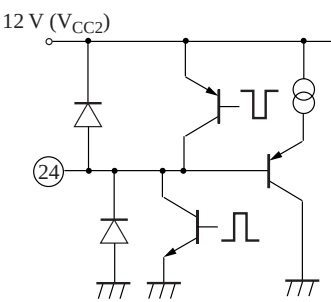
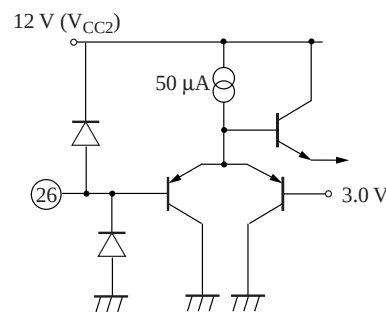
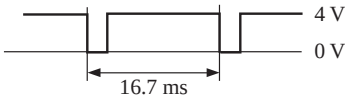
■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit                                                                  | Description                                                                                                                                                                             | Voltage               |
|---------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| 16      |    | Vertical feedback input pin:<br><br>V out<br><br><br>Short-circuit this pin with pin 17 in normal use | AC                    |
| 17      |    | Vertical output pin:<br><br>V out<br><br><br>Short-circuit this pin with pin 16 in normal use         | AC                    |
| 18      |   | EW output pin:<br><br>EW out<br>                                                                     | AC                    |
| 19      |  | Upper and lower corner slice voltage input pin                                                                                                                                          | DC<br>0 V to<br>1.5 V |

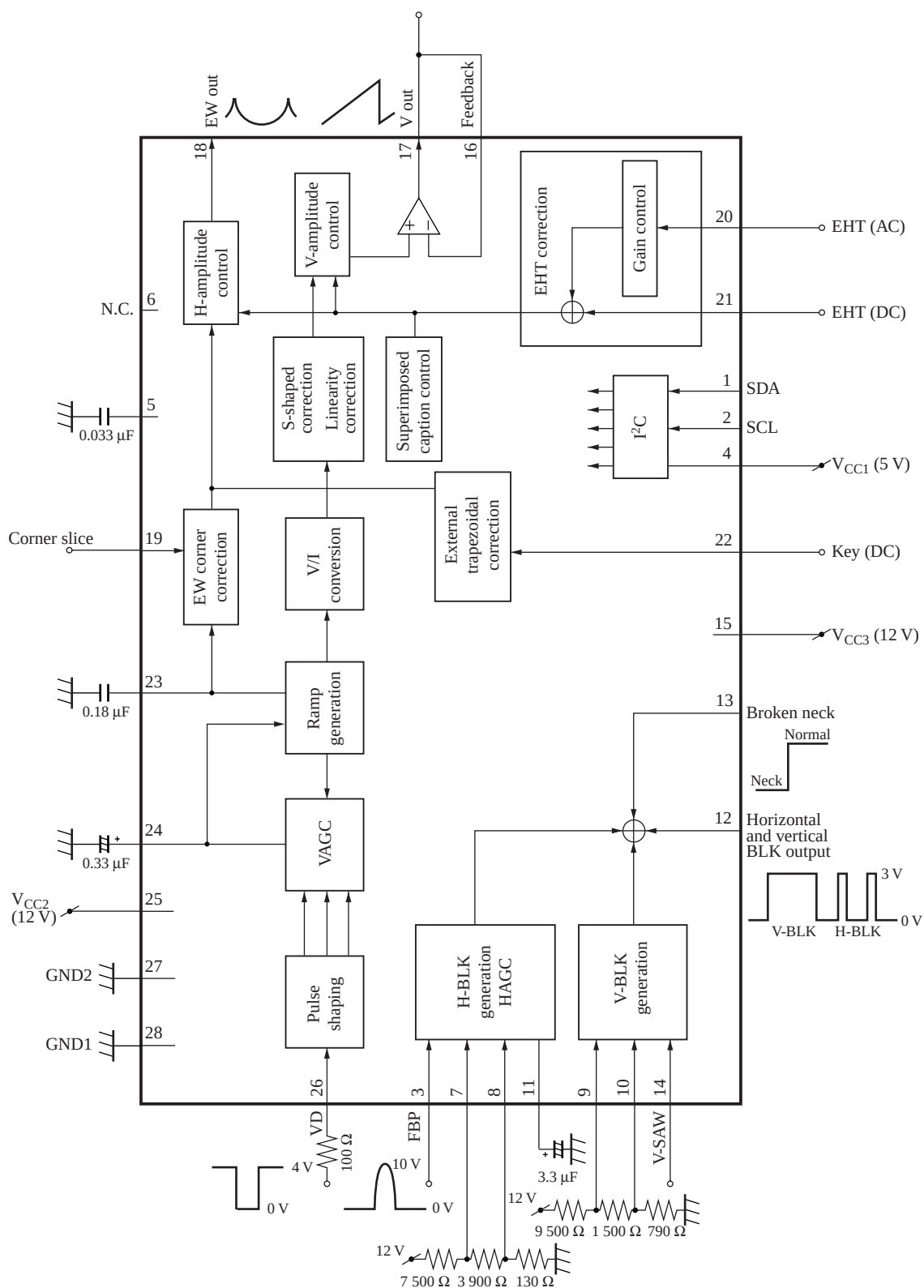
■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit | Description                                             | Voltage                                 |
|---------|--------------------|---------------------------------------------------------|-----------------------------------------|
| 20      |                    | EHT-AC input pin                                        | AC<br>Open<br>approx. 2.9 V             |
| 21      |                    | EHT-DC input pin                                        | DC<br>6 V to 10 V<br>(typ. 8 V)         |
| 22      |                    | External shape trapezoidal correction<br>DC control pin | DC<br>1.5 V to<br>3.5 V<br>(typ. 2.5 V) |
| 23      |                    | Ramp reference waveform generation<br>pin:<br>          | AC                                      |

■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit                                                                 | Description                                                                                              | Voltage       |
|---------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------|
| 24      |   | AGC pin for ramp                                                                                         | AC            |
| 25      | —                                                                                  | $V_{CC2}$ (typ. 12 V):<br>For I <sup>2</sup> C circuit and correction system circuit                     | DC            |
| 26      |  | V pulse input pin:<br> | AC<br>(Pulse) |
| 27      | —                                                                                  | GND2:<br>For analog circuit block                                                                        | DC            |
| 28      | —                                                                                  | GND1:<br>For digital circuit block                                                                       | DC            |

# Application Circuit Example



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