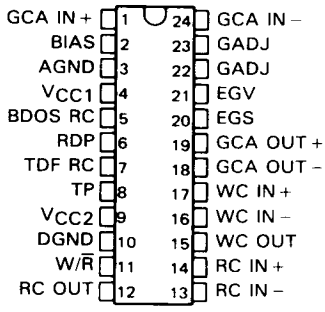
D3024, AUGUST 1987—REVISED SEPTEMBER 1989

- **Designed for Signal Processing in Streaming-Tape Memory Units in Combination with TL040 Two-Channel Video Amplifier**
- **Space-Saving LSI Circuits Include:**
  - **Two High-Speed Differential Comparators**
  - **Time-Domain Filter**
  - **Bidirectional One-Shot Multivibrator**
  - **Gain-Controlled Video Amplifier with Differential Inputs and Outputs**
- **Amplifier and Comparator Bandwidth . . . 20 MHz Typical**
- **Maximum Data Rate at Read Data Pulse (RDP) . . . 1.4 Mb/s Typical**
- **Available in 300-mil Dual-In-Line and "Small Outline" Plastic Packages**

**DW OR NT PACKAGE**
**(TOP VIEW)**




## description

The TL041AC is a magnetic tape read signal conditioner designed for use with the TL040 video amplifier. When combined, these devices amplify the low-signal output from a streaming-tape playback head and reconstruct the data as originally written on the tape. The TL041AC includes a gain-controlled amplifier, two comparators, read/write select logic, a time-domain filter, and a bidirectional one-shot multivibrator.

The amplifier has differential inputs, differential outputs, and electronic gain control. A special feature of the electronic gain control is the Electronic Gain Select (EGS). When the EGS input is high, the Electronic Gain Voltage (EGV) input is driven low and amplifier gain is determined by the value of the resistor connected between the Gain Adjust (GADJ) pins. When the EGS input is low, the gain set by the resistor is increased by an amount determined by the voltage applied to the EGV pin.

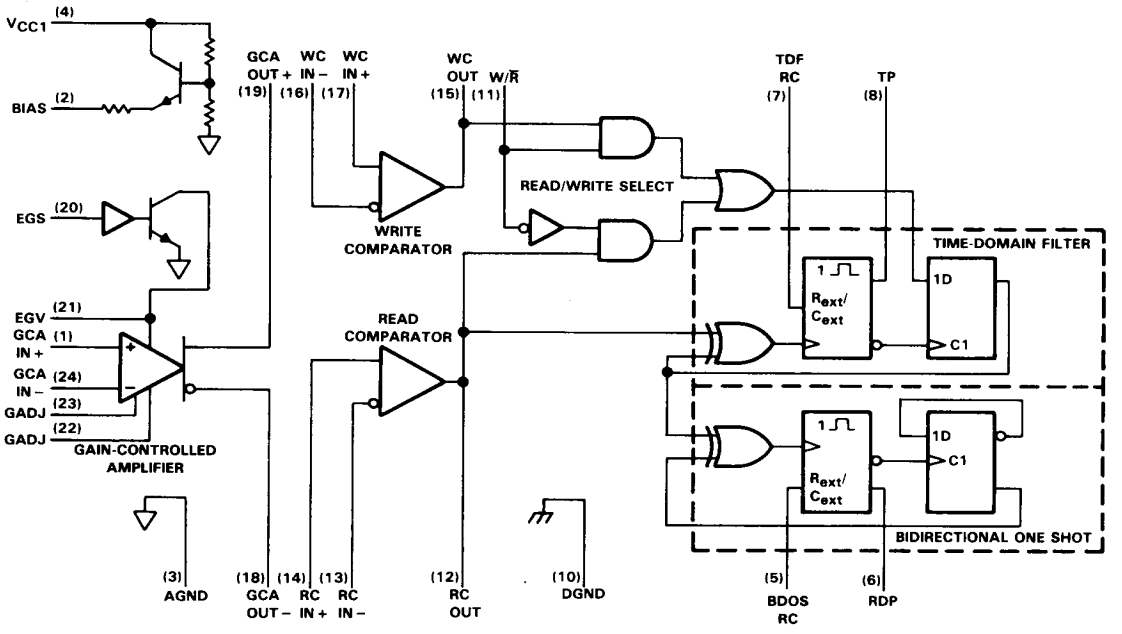
To accommodate different magnetic tape output signal levels, the amplifier gain may be switched by logic at the EGS input, controlled manually with an adjustable voltage at the EGV input, or automatically adjusted with an automatic gain control (AGC) circuit applying a control voltage to the EGV input.

The comparator functions are controlled by a logic input to the Write/Read (W/$\overline{R}$) select input. With the W/$\overline{R}$ input low, the read comparator output (usually connected as a zero-crossing detector) is sent to the time-domain filter. When W/$\overline{R}$ is high, the write comparator output is used to provide write amplitude verification in a typical read-after-write function.

The time-domain filter helps to ensure the input data is valid. A capacitor in series with a resistor, connected to the time-domain filter pin (TDF RC), begins charging at the leading edge of an input pulse from the read comparator. If the input pulse does not remain high for one RC time constant, the pulse is considered invalid and no signal is passed to the bidirectional one-shot multivibrator (BDOS). However, if the input pulse remains high for longer than one RC time constant, the pulse is considered valid and the signal is passed through the time-domain filter to trigger the BDOS. When triggered, the BDOS provides a pulse to the Read Data Pulse (RDP) output. The RDP output pulse duration is determined by a resistor-capacitor network connected to the BDOS RC pin.

The TL041AC is characterized for operation from 0°C to 70°C.

## functional block diagram




**FUNCTION TABLE**

| INPUT CONDITONS | | | I/O NAME | I/O CONDITION |
|---|---|---|---|---|
| EGS | W/R̄ | DIFFERENTIAL INPUTS WRITE OR READ COMPARATOR | | |
| | X | RC IN+ > RC IN– | RC OUT | H |
| | X | RC IN– > RC IN+ | RC OUT | L |
| | L | X | RC OUT | Input to time-domain filter |
| | X | WC IN+ > WC IN– | WC OUT | H |
| | X | WC IN– > WC IN+ | WC OUT | L |
| | H | X | WC OUT | Input to time-domain filter |
| H | | X | EGV | L |
| L | | X | EGV | Input |



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| PIN NAME | PIN NO. | DESCRIPTION |
|---|---|---|
| AGND | 3 | Analog ground |
| BDOS RC | 5 | Bidirectional one-shot resistor and capacitor |
| BIAS | 2 | Output bias voltage |
| DGND | 10 | Digital ground |
| EGS | 20 | Electronic gain select |
| EGV | 21 | Electronic gain voltage |
| GCA IN− | 24 | Gain-controlled amplifier, inverting input |
| GCA IN+ | 1 | Gain-controlled amplifier, noninverting input |
| GADJ | 22 | Gain adjust |
| GADJ | 23 | Gain adjust |
| GCA OUT− | 18 | Gain-controlled amplifier, inverting output |
| GCA OUT+ | 19 | Gain-controlled amplifier, noninverting output |
| RC IN− | 13 | Read comparator, inverting input |
| RC IN+ | 14 | Read comparator, noninverting input |
| RC OUT | 12 | Read comparator out |
| RDP | 6 | Read data pulse |
| TDF RC | 7 | Time-domain filter resistor and capacitor |
| TP | 8 | Test point |
| $V_{CC1}$ | 4 | Analog collector supply voltage |
| $V_{CC2}$ | 9 | Digital collector supply voltage |
| WC IN− | 16 | Write comparator, inverting input |
| WC IN+ | 17 | Write comparator, noninverting input |
| WC OUT | 15 | Write comparator out |
| W/$\overline{R}$ | 11 | Write/read |

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage: $V_{CC1}$ (see Note 1) . . . . . 14 V
$V_{CC2}$ . . . . . 7 V
Input voltage range: Amplifier and comparators . . . . . AGND − 0.2 V to $V_{CC1}$ + 0.2 V
Multivibrators and logic . . . . . AGND − 0.2 V to $V_{CC2}$ + 0.2 V
Input current: EGV (see Note 2) . . . . . ±2 mA
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from the case for 10 seconds . . . . . 260°C

NOTES: 1. All voltages except differential voltages are with respect to network ground terminals (AGND and DGND tied together).
2. Driving EGV high from a low-impedance source (> ±2 mA capability) with EGS high can result in damage to the device.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \leq 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING |
|---|---|---|---|
| DW | 1350 mW | 10.8 mW/°C | 864 mW/°C |
| NT | 1700 mW | 13.6 mW/°C | 1088 mW/°C |

### recommended operating conditions

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| Supply voltage, $V_{CC1}$ | | 10.8 | 12 | 13.2 | V |
| Supply voltage, $V_{CC2}$ | | 4.5 | 5 | 5.5 | V |
| High-level input voltage, $V_{IH}$ | EGS or W/$\overline{R}$ | 2 | | | V |
| Low-level input voltage, $V_{IL}$ | EGS or W/$\overline{R}$ | | | 0.8 | V |
| Input voltage, $V_I$ | EGS | 0 | | 10 | V |
| | EGV | 0 | | $0.8V_{CC1}$ | |
| Common-mode input voltage to gain-control amplifier, $V_{IC}$ | | | 4 | | V |
| High-level output current, $I_{OH}$ | WC OUT, RC OUT, TP, or RDP | | | −400 | μA |
| Low-level output current, $I_{OL}$ | WC OUT, RC OUT, TP, or RDP | | | 8 | mA |
| Pulse duration, $t_w$ | TP or RDP | 40 | | | ns |
| External timing resistance, (see Note 3) | TDF or BDOS RC | 5 | | 25 | kΩ |
| External timing capacitance | TDF or BDOS RC) | 0.01 | 0.1 | 1000 | nF |
| Operating free-air temperature, $T_A$ | | 0 | | 70 | °C |

NOTE 3: Some high resistance and capacitance combinations may produce abnormal output waveforms.



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**electrical characteristics at $V_{CC1}$ = 12 V, $V_{CC2}$ = 5 V, $V_{IC(GIC)}$ = $V_{bias}$, $R_{ADJ}$ = 5 kΩ, EGS at high level, EGV at 0 V, $r_j$ = 50 Ω, $R_L$ = 2 kΩ, $T_A$ = 25°C (unless otherwise noted)**

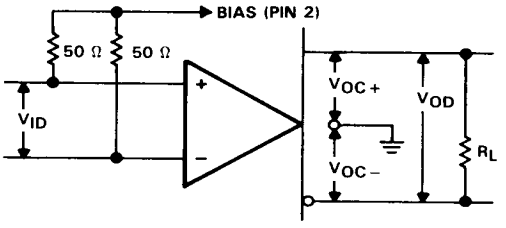
**gain-controlled amplifier**

| PARAMETER | | TEST FIGURE | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OO}$ | Output offset voltage | 1 | $V_{ID}$ = 0, | $V_{OD}$ = $V_O$ | | 0.35 | 0.75 | V |
| $V_{OPP}$ | Maximum differential output voltage | 1 | $V_{ID}$ = 1 V, | $V_{OPP}$ = $V_O$ | 3 | 6 | | V |
| $A_{VD}$ | Large-signal differential voltage amplification | 1 | $V_{ID}$ = 20 mV, | EGS high | 8 | 14 | 20 | V/V |
| | | | $V_{id}$ = 20 mV, EGS low, f = 455 kHz | EGV at 4 V | | 19 | | V/V |
| | | | | EGV at 9.6 V | | 90 | | |
| CMRR | Common-mode rejection ratio | 2 | $V_{IC}$ = 2 V to 5 V | | 60 | 80 | | dB |
| $V_{IC}$ | Common-mode input voltage | 2 | | | 2 | | 5 | V |
| $V_{OC}$ | Common-mode output voltage | 1 | $V_{ID}$ = 0 | | 4 | 5.8 | 6.4 | V |
| $I_{IO}$ | Input offset current | 1 | $I_{IB+} - I_{IB-}$ | | | 0.2 | 3 | μA |
| $I_O$ | Output current, sink | | | | 1.5 | 2 | | mA |
| $I_{IB}$ | Input bias current | 1 | $(I_{IB+} + I_{IB-})/2$ | | | 5 | 17 | μA |
| $V_{O(BIAS)}$ | Bias output voltage | 1 | | | 3 | 4 | 5 | V |
| $z_{o(BIAS)}$ | Bias output impedance | | | | | 1 | | kΩ |
| $z_i$ | Input impedance | | | | | 30 | | kΩ |
| BW | Bandwidth (−3 dB) | 3 | | | | 20 | | MHz |
| $k_{SVR}$ | Supply voltage rejection ratio | 4 | $V_{CC1}$ = 10.8 V to 13.2 V | | 50 | 70 | | dB |
| $I_{CC1}$ | Supply current from $V_{CC1}$ | | $V_{CC1}$ = 13.2 V, | No signal | | 32 | 45 | mA |

**logic section**

| PARAMETER | | | TEST FIGURE | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | | | $V_{CC2}$ = 4.5 V, $I_{OH}$ = −400 μA | $V_{ID}$ = 0.1 V, | 2.7 | 3.5 | | V |
| $V_{OL}$ | Low-level output voltage | | | $V_{CC2}$ = 4.5 V, $I_{OL}$ = 8 mA | $V_{ID}$ = 0.1 V, | | 260 | 500 | mV |
| $V_{ICR}$ | Common-mode input voltage, comparators | | | | | 2 | | 7 | V |
| $I_{IH}$ | High-level input current | EGS | | $V_{I(EGS)}$ = 2.7 V | | | 120 | 200 | μA |
| | | W/$\overline{R}$ | | $V_{I(W/\overline{R})}$ = 2.7 V | | | | 20 | |
| $I_{IL}$ | Low-level input current | EGS | | $V_{I(EGS)}$ = 0.4 V | | | | −20 | μA |
| | | W/$\overline{R}$ | | $V_{I(W/\overline{R})}$ = 0.4 V | | | | −400 | |
| $I_{CC2}$ | Supply current from $V_{CC2}$ | | | $V_{CC2}$ = 5.5 V, | No signal | | 22 | 31 | mA |
| | Response time | | | 100-mV step, | 5-mV overdrive | | 50 | | ns |
| $t_w$ | Pulse duration of one-shots (TP, RDP) | | | $R_{ext}$ = 5 kΩ, | $C_{ext}$ = 100 pF | | 360 | | ns |
| | | | | $R_{ext}$ = 20 kΩ, | $C_{ext}$ = 33 pF | | 460 | | |

## PARAMETER MEASUREMENT INFORMATION




$V_{OO} = V_{OD}$ with $V_{ID} = 0$

$V_{OPP} = V_{OD}$ with $V_{ID} = 1$ V

$A_{VD} = \frac{V_{OD}}{V_{ID}}$ with $V_{ID} = 20$ mV

$V_{OC} = \frac{V_{OC+} + V_{OC-}}{2}$ with $V_{ID} = 0$

FIGURE 1

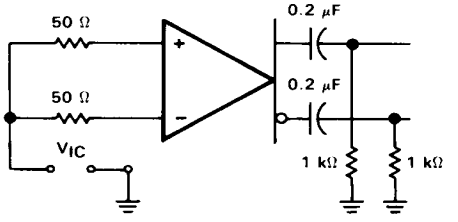



FIGURE 2

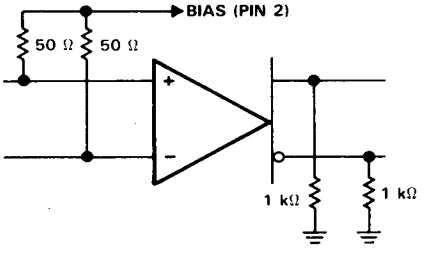



FIGURE 3

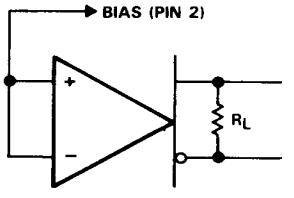



FIGURE 4



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## TYPICAL CHARACTERISTICS

READ DATA PULSE DURATION
vs
CAPACITANCE

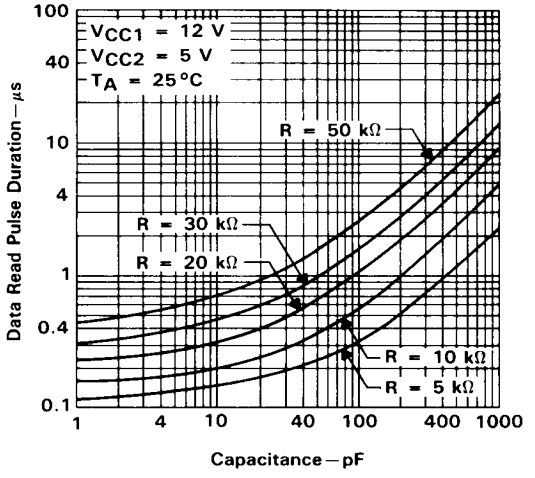


FIGURE 5

LARGE-SIGNAL DIFFERENTIAL
VOLTAGE AMPLIFICATION
vs
ELECTRONIC GAIN VOLTAGE

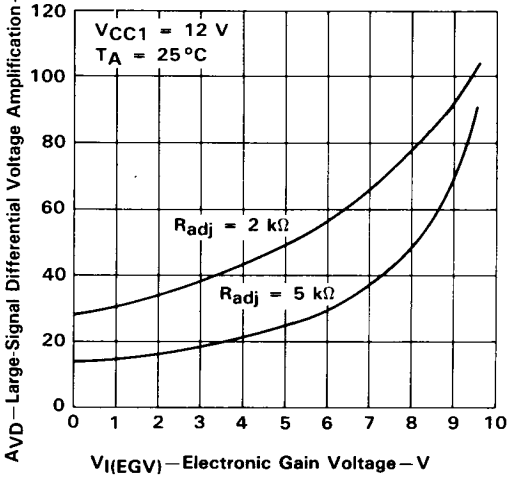


FIGURE 6

## TYPICAL APPLICATION DATA

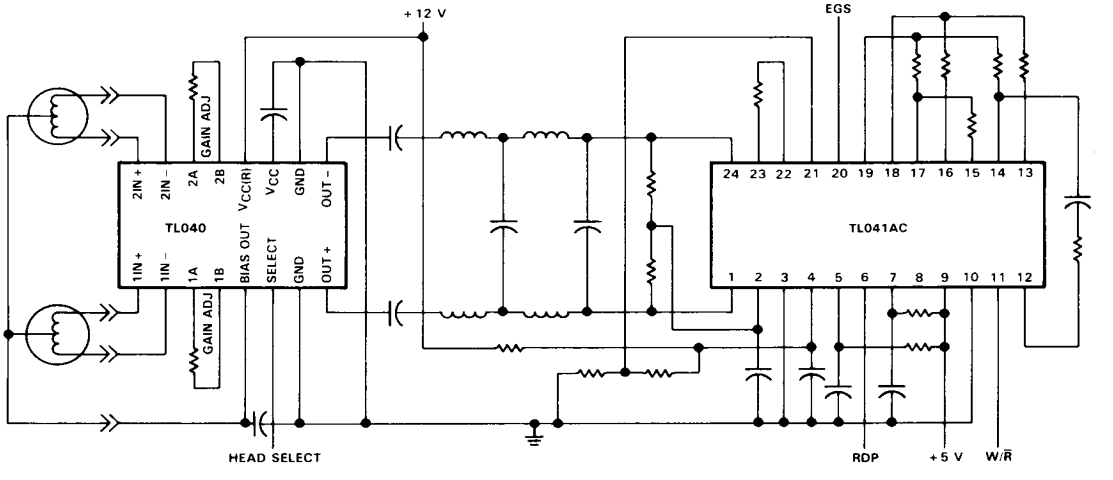


FIGURE 7. READ SIGNAL CIRCUIT FOR A STREAMING TAPE DRIVE