



54ACT/74ACT818 8-Bit Diagnostic Register

General Description

The 'ACT818 is a high-speed, general-purpose pipeline register with an on-board diagnostic register for performing serial diagnostics and/or writable control store loading.

The D-to-Y path provides an 8-bit parallel data path pipeline register for normal system operation. The diagnostic register can load parallel data to or from the pipeline register and can output data through the D input port (as in WCS loading).

The 8-bit diagnostic register has multiplexer inputs that select parallel inputs from the Y-port or adjacent bits in the diagnostic register to operate as a right-shift-only register. This register can then participate in a serial loop throughout the system where normal data, address, status and control registers are replaced with 'ACT818 diagnostic pipeline registers. The loop can be used to scan in a complete test routine starting point (Data, Address, etc.). Then after a specified number of machine cycles it scans out the results to be inspected for the expected results. WCS loading can be accomplished using the same technique. An instruction word can be serially shifted into the shadow register and written into the WCS RAM by enabling the D output.

Features

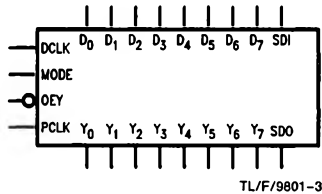
- On-line and off-line system diagnostics
- Swaps the contents of diagnostic register and output register
- Diagnostic register and diagnostic testing
- Cascadable for wide control words as used in microprogramming
- Edge-triggered D registers
- Outputs source/sink 24 mA
- 'ACT818 has TTL-compatible inputs
- 'ACT818 is functionally- and pin-compatible to AMD Am29818 and MMI 74S818

Applications

- Register for microprogram control store
- Status register
- Data register
- Instruction register
- Interrupt mask register
- Pipeline register
- General purpose register
- Parallel-serial/serial-parallel converter

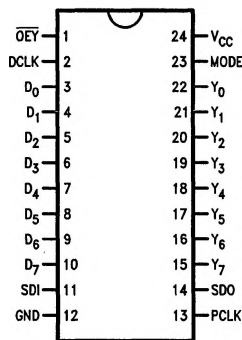
Ordering Code: See Section 8

Logic Symbol

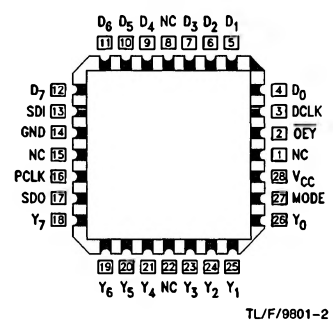


Connection Diagrams

**Pin Assignment
for DIP, Flatpak and SOIC**

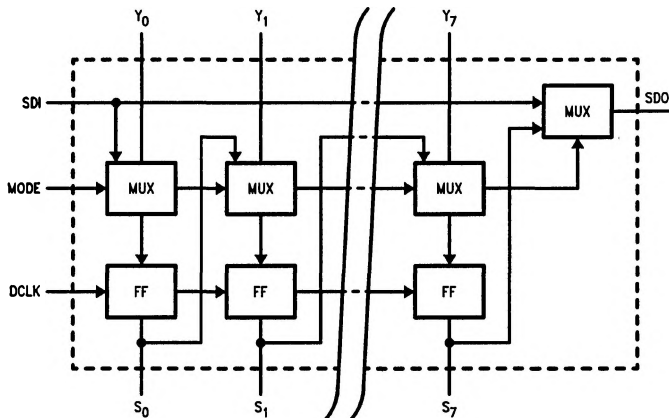


**Pin Assignment
for LCC and PCC**



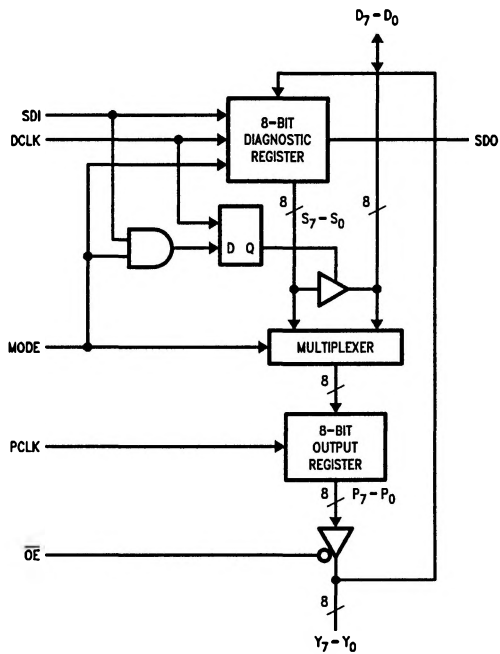
Pin Names	Description
D ₀ -D ₇	Data Inputs
SDI	Serial Data Input
DCLK	Diagnostics Clock
MODE	Control Input
PCLK	Pipeline Register Clock
OEY	Output Enable Input
SDO	Serial Data Output
Y ₀ -Y ₇	Data Outputs

Diagnostic Register



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Block Diagram








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Functional Description

Data transfers into the diagnostic register occur on the LOW-to-HIGH transition of DCLK. Mode and SDI determine what data source will be loaded. The pipeline register is loaded on the LOW-to-HIGH transition of PCLK. Mode selects whether the data source is the data input or the diag-

nostic register output. Because of the independence of the clock inputs, data can be shifted in the diagnostic register via DCLK and loaded into the pipeline register from the data input via PCLK simultaneously, as long as no setup or hold times are violated. This simultaneous operation is legal.

Function Table

Inputs				Outputs			Operation
SDI	MODE	DCLK	PCLK	SDO	Diagnostic Reg.	Pipeline Reg.	
X	L		X	S7	SI < SI - 1, SO < SD _i	NA	Serial Shift; D ₇ -D ₀ Disabled
X	L	X		S7	NA	PI < DI	Normal Load Pipeline Register
L	H		X	L	SI < Y _i	NA	Load Diagnostic Register from Y; DI Disabled
X	H	X		SDI	NA	PI < SI	Load Pipeline Register from Diagnostic Register
H	H		X	H	Hold	NA	Hold Diagnostic Register; DI Enabled

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

 = LOW-to-HIGH Clock Transition

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	-0.5V to +7.0V
DC Input Diode Current (I_{IK})	
$V_I = -0.5V$	-20 mA
$V_I = V_{CC} + 0.5V$	+20 mA
DC Input Voltage (V_I)	-0.5V to $V_{CC} + 0.5V$
DC Output Diode Current (I_{OK})	
$V_O = -0.5V$	-20 mA
$V_O = V_{CC} + 0.5V$	+20 mA
DC Output Voltage (V_O)	-0.5V to $V_{CC} + 0.5V$
DC Output Source or Sink Current (I_O)	± 50 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	± 50 mA
Storage Temperature (T_{STG})	-65°C to +150°C
Junction Temperature (T_J)	
CDIP	175°C
PDIP	140°C

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT™ circuits outside databook specifications.

Recommended Operating Conditions

Supply Voltage (V_{CC})	
'AC	2.0V to 6.0V
'ACT	4.5V to 5.5V
Input Voltage (V_I)	0V to V_{CC}
Output Voltage (V_O)	0V to V_{CC}
Operating Temperature (T_A)	
74AC/ACT	-40°C to +85°C
54AC/ACT	-55°C to +125°C
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'AC Devices	
V_{IN} from 30% to 70% of V_{CC}	
V_{CC} @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'ACT Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V_{CC} (V)	74ACT		54ACT		74ACT		Units	Conditions
			$T_A = +25^\circ\text{C}$		$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$			
			Typ	Guaranteed Limits						
V_{IH}	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0		2.0		V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	1.5	2.0	2.0		2.0			
V_{IL}	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8		0.8		μA	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	1.5	0.8	0.8		0.8			
I_{IN}	Maximum Input Leakage Current	5.5		± 0.1	± 10.0		± 1.0		μA	$V_{IN} = V_{CC}$
I_{OZ}	Maximum TRI-STATE Leakage Current	5.5		± 0.5	± 10.0		± 5.0		μA	$O\bar{E} = V_{IH}$ $V_{OUT} = 0V, V_{CC}$
I_{CC}	Maximum Quiescent Supply Current	5.5		1.0					mA	$V_{IN} = V_{CC}$ or GND
I_{CCT}	Maximum Additional I_{CC} /Input	5.5			1.6		1.5		mA	$V_{IN} = V_{CC} - 2.1V$ $V_{CC} = 5.5V$
V_{OH}	Minimum HIGH Level Output Voltage, Y_0 - Y_7 Outputs	4.5		3.86	3.70		3.76		V	* $V_{IN} = V_{IL}$ or V_{IH} $I_{OH} = -24$ mA $I_{OH} = -24$ mA
		5.5		4.86	4.70		4.76		V	
	Minimum HIGH Level Output Voltage, D_0 - D_7 , SDO Outputs	4.5		3.86	3.70		3.76		V	$I_{OH} = -8$ mA $I_{OH} = -8$ mA
		5.5		4.86	4.70		4.76		V	
V_{OL}	Maximum LOW Level Output Voltage, Y_0 - Y_7 Outputs	4.5		0.36	0.50		0.44		V	* $V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 24$ mA $I_{OL} = 24$ mA
		5.5		0.36	0.50		0.44		V	
	Maximum LOW Level Output Voltage, D_0 - D_7 , SDO Outputs	4.5		0.36	0.50		0.44		V	$I_{OL} = 8$ mA $I_{OL} = 8$ mA
		5.5		0.36	0.50		0.44		V	
I_{OLD}	Minimum Dynamic Output Current, Y_0 - Y_7 Outputs	5.5			50		75		mA	$V_{OLD} = 1.65V$ Max

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

DC Characteristics for 'ACT Family Devices (Continued)

Symbol	Parameter	V _{CC} (V)	74ACT		54ACT		74ACT		Units	Conditions
			T _A = +25°C		T _A = -55°C to +125°C		T _A = -40°C to +85°C			
			Typ	Guaranteed Limits						
I _{OHD}	Minimum Dynamic Output Current, Y ₀ -Y ₇ Outputs	5.5			-50			-75	mA	V _{OHD} = 3.85V Min
I _{OLD}	Minimum Dynamic Output Current, D ₀ -D ₇ , SDO Outputs (Note 1)	5.5			32			32	mA	V _{OLD} = 1.65V Max
I _{OHD}	Minimum Dynamic Output Current, D ₀ -D ₇ , SDO Outputs (Note 1)	5.5			-32			-32	mA	V _{OHD} = 3.85V Min

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

Note 1: Test load 50 pF, 500Ω to ground.

Note: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.

AC Electrical Characteristics: See Section 2 for Waveforms

Symbol	Parameter	V _{CC} * (V)	74ACT			54ACT		74ACT		Units	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = -55°C to +125°C C _L = 50 pF		T _A = -40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max	Min	Max		
t _{PHL}	Propagation Delay PCLK to Y	5.0	3.0	6.0	9.0	1.5	10.5	2.5	9.5	ns	2-3, 4
t _{PLH}	Propagation Delay PCLK to Y	5.0	3.0	6.5	9.0	1.5	11.0	2.5	10.0	ns	2-3, 4
t _{PHL}	Propagation Delay MODE to SDO	5.0	4.0	8.0	11.0	1.5	13.0	3.5	12.0	ns	2-3, 4
t _{PLH}	Propagation Delay MODE to SDO	5.0	4.0	8.0	11.5	1.5	14.0	4.0	12.5	ns	2-3, 4
t _{PHL}	Propagation Delay SDI to SDO	5.0	3.5	7.5	10.5	1.5	12.5	3.0	12.0	ns	2-3, 4
t _{PLH}	Propagation Delay SDI to SDO	5.0	3.5	7.5	10.5	1.5	13.0	3.5	12.0	ns	2-3, 4
t _{PHL}	Propagation Delay DCLK to SDO	5.0	4.5	9.0	12.5	1.5	15.5	4.0	14.0	ns	2-3, 4
t _{PLH}	Propagation Delay DCLK to SDO	5.0	4.5	9.5	13.0	1.5	16.0	4.0	14.5	ns	2-3, 4
t _{PZL}	Output Enable Time OEY to Y _n	5.0	2.5	6.0	9.0	1.5	11.0	2.5	10.0	ns	2-6
t _{PLZ}	Output Disable Time OEY to Y _n	5.0	1.5	5.5	8.0	1.5	9.5	1.0	9.0	ns	2-6
t _{PZL}	Output Enable Time DCLK to D _n	5.0	3.0	8.0	12.0	1.5	15.0	3.0	13.5	ns	2-6
t _{PLZ}	Output Disable Time DCLK to D _n	5.0	2.0	8.5	11.0	1.5	13.0	1.5	12.0	ns	2-6
t _{PZH}	Output Enable Time OEY to Y _n	5.0	3.0	8.0	10.0	1.5	12.0	2.5	11.0	ns	2-5
t _{PHZ}	Output Disable Time OEY to Y _n	5.0	2.5	9.0	11.0	1.5	13.0	2.0	11.5	ns	2-5
t _{PZH}	Output Enable Time DCLK to D _n	5.0	3.0	6.5	11.5	1.5	14.0	3.0	13.0	ns	2-5
t _{PHZ}	Output Disable Time DCLK to D _n	5.0	3.0	7.5	12.0	1.5	14.0	2.0	13.0	ns	2-5

*Voltage Range 5.0 is 5.0V ±0.5V.

AC Operating Requirements: See Section 2 for Waveforms

Symbol	Parameter	V _{CC} * (V)	74ACT		54ACT	74ACT		Units	Fig. No.
			T _A = +25°C C _L = 50 pF		T _A = -55°C to +125°C C _L = 50 pF	T _A = -40°C to +85°C C _L = 50 pF			
			Typ	Guaranteed Minimum					
t _s	Setup Time D to PCLK	5.0	1.0	4.0	6.0	5.0	ns	2-7	
t _h	Hold Time D to PCLK	5.0	0.0	1.0	1.5	1.0	ns	2-7	
t _s	Setup Time MODE to PCLK	5.0	2.5	4.5	6.5	5.5	ns	2-7	
t _h	Hold Time MODE to PCLK	5.0	-1.0	0.0	0.5	0.0	ns	2-7	
t _s	Setup Time Y to DCLK	5.0	0.5	2.5	3.5	2.5	ns	2-7	
t _h	Hold Time Y to DCLK	5.0	0	1.0	2.0	1.5	ns	2-7	
t _s	Setup Time MODE to DCLK	5.0	2.0	4.0	5.0	4.0	ns	2-7	
t _h	Hold Time MODE to DCLK	5.0	-0.5	1.0	1.5	1.0	ns	2-7	
t _s	Setup Time SDI to DCLK	5.0	2.0	3.5	5.5	4.5	ns	2-7	
t _h	Hold Time SDI to DCLK	5.0	-0.5	1.0	1.5	1.0	ns	2-7	
t _s	Setup Time DCLK to PCLK	5.0	6.0	9.0	12.0	10.5	ns	2-7	
t _s	Setup Time PCLK to DCLK	5.0	6.0	11.0	12.5	11.5	ns	2-7	
t _w	Pulse Width PCLK HIGH or LOW	5.0	2.0	3.0	4.5	3.0	ns	2-3	
t _w	Pulse Width DCLK HIGH or LOW	5.0	2.0	3.0	4.5	3.0	ns	2-3	

Note 1: Test load 50 pF, 500Ω to ground.

*Voltage range 5.0 is 5.0V ± 0.5V.

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0V
C _{PD}	Power Dissipation Capacitance	20	pF	V _{CC} = 5.0V