DS3654

DS3654 Printer Solenoid Driver

Literature Number: SNLS363A

National Semiconductor

August 1992

DS3654 Printer Solenoid Driver

General Description

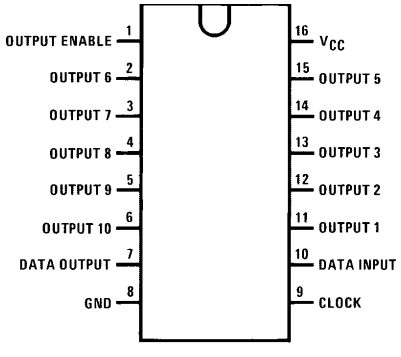
The DS3654 is a serial-to-parallel 10-bit shift register with a clock and data input, a data output from the tenth bit, and 10 open-collector clamped relay driver outputs suitable for driving printer solenoids.

Timing for the circuit is shown in *Figure 1*. Data input is sampled on the positive clock edge. Data output changes on the negative clock edge, and is always active. Enable transfers data from the shift register to the open-collector outputs. Internal circuitry inhibits output enable for power supply voltage less than 6V.

Each output sinks 250 mA and is internally clamped to ground at 50V to dissipate energy stored in inductive loads.

Connection Diagram

Dual-In-Line Package



TL/F/5817–1

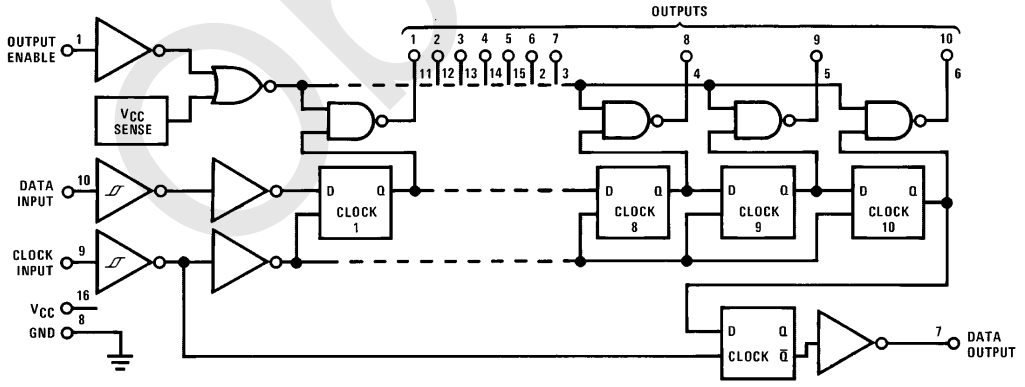
Top View

Order Number DS3654N
See NS Package Number N16E

Pin Descriptions

Pin No.	Function
1	Output Enable
2	Output 6
3	Output 7
4	Output 8
5	Output 9
6	Output 10
7	Data Output
8	Ground
9	Clock Input
10	Data Input
11	Output 1
12	Output 2
13	Output 3
14	Output 4
15	Output 5
16	V_{CC}

Logic Diagram



TL/F/5817–2

  RRD-B30M105/Printed in U. S. A.

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}	9.5V Max
Input Voltage	−0.5V Min. 9.5V Max
Output Supply, Vp-p	45V Max
Storage Temperature Range	−65°C to +150°C
Output Current (Single Output)	0.4A
Ground Current	4.0A
Peak Power Dissipation t < 10 ms, Duty Cycle < 5%	4.5W Max
Maximum Power Dissipation* at 25°C Molded Package	1687 mW
Lead Temperature (Soldering, 4 seconds)	260°C

*Derate molded package 13.5 mW/°C above 25°C.

Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	7.5	9.5	V
Temperature (T_A)	0	+70	°C
Output Supply (Vp-p)		40	V

Electrical Characteristics (Notes 2, 3 and 4) Vp-p = 30V unless otherwise noted

Parameter	Conditions	Min	Typ	Max	Units
Logical "1" Input Voltage		2.6			V
Logical "0" Input Voltage				0.8	V
Logical "1" Output Voltage Clamp	I_{CLAMP} = 0.1A, V_{EN} = 0V	45	50	65	V
Logical "1" Output Current	V_{OH} = 40V, V_{EN} = 0V			1.0	mA
Logical "0" Output Voltage	I_{OL} = 250 mA, V_{EN} = 2.6V			1.6	V
Logical "1" Input Current					
Clock	T_A = 70°C, V_{CL} = 2.6V	0.2	0.33		mA
Enable	T_A = 70°C, V_{EN} = 2.6V	0.2	0.33		mA
Data	T_A = 70°C, V_D = 2.6V	0.3	0.57		mA
Clock	T_A = 0°C, V_{CL} = 2.6V		0.33	0.5	mA
Enable	T_A = 0°C, V_{EN} = 2.6V		0.33	0.5	mA
Data	T_A = 0°C, V_D = 2.6V		0.57	0.75	mA
Logical "0" Input Current					
Clock	T_A = 70°C, V_{CL} = 1V		125		μA
Enable	T_A = 70°C, V_{EN} = 1V		125		μA
Data	T_A = 70°C, V_D = 1V		220		μA
Input Pull-Down Resistance					
Clock	T_A = 25°C, V_{CL} < V_{CC}		8		kΩ
Enable	T_A = 25°C, V_{EN} < V_{CC}		8		kΩ
Data	T_A = 25°C, V_D < V_{CC}		4.5		kΩ
Supply Current (I_{CC})					
Outputs Disabled	$T_A \geq$ 25°C, V_{EN} = 0V, V_{DO} = 0V, V_{CC} = 9.5V		27	40	mA
Outputs Enabled	$T_A \geq$ 25°C, V_{EN} = 2.6V, I_{OL} = 250 mA Each Bit		55	70	mA
Data Output Low (V_{DOL})	V_D = 0V, I_{OL} = 0V		0.01	0.5	V
Data Output High (V_{DOH})	V_D = 2.6V, I_{OH} = −0.75 mA	2.6	3.4		V
Data Output Pull-Down Resistance	V_D = 0V, V_{D0} = 1V		14		kΩ

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.

Note 2: Unless otherwise specified, min/max limits apply across the 0°C to +70°C temperature range and the 7.5V to 9.5V power supply range. All typical values given are for V_{CC} = 8.5V and T_A = 25°C.

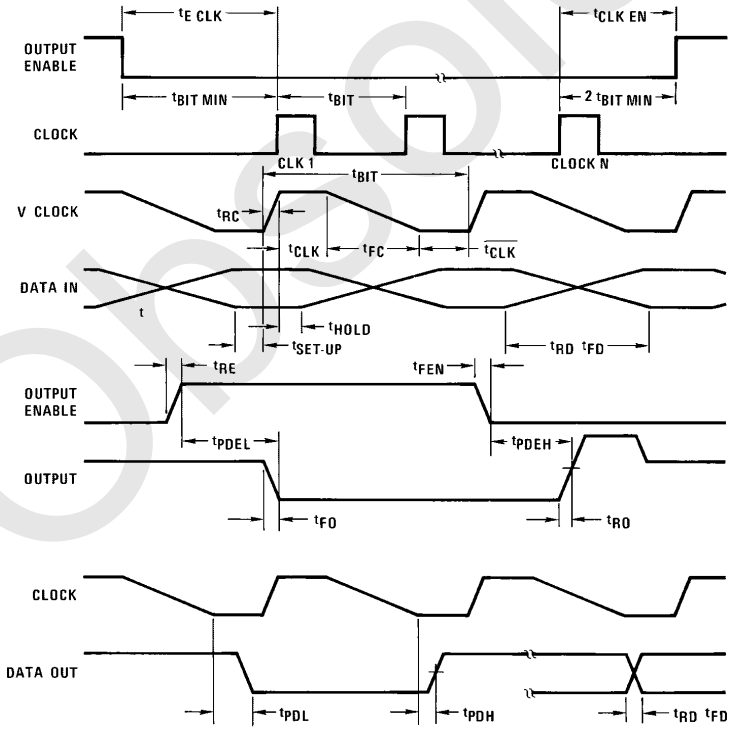
Note 3: All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

Note 4: Only one output at a time should be shorted.

Switching Characteristics 0°C to +70°C, T_A = 25°C, nominal power supplies unless otherwise noted

Parameter	Conditions	Min	Typ	Max	Units
Clk, Data and Enable Inputs	*(Figure 1)*				
t_{FC}				2.0	μs
t_{RC}	$t_{BIT} \geq 10\ \mu s$			2.0	μs
t_{CLK}		2			μs
$\overline{t_{CLK}}$		3.5			μs
t_{HOLD}				1.0	μs
$t_{SET\text{-}UP}$				1.0	μs
t_{RE},$t_{RD\ IN}$				1.0	μs
t_{FE}, $t_{FD\ IN}$				5.0	μs
Output 1–10	Vp-p = 20V				
t_{RO}	$R_L = 100\Omega$, $C_L < 100$ pF		1.2		μs
t_{FO}	$R_L = 100\Omega$, $C_L < 100$ pF		1.2		μs
t_{PDEH}			3.5		μs
t_{PDEL}			3.0		μs
Data Output					
t_{PDH}, t_{PDL}	$R_L = 5\ k\Omega$, $C_L \leq 10$ pF		0.8	2.5	μs
t_{RD}			0.4		μs
t_{FD}			0.4		μs
Clock to Enable Delay					
t_{CE}		2 t_{BIT}			μs
Enable to Clock Delay		t_{BIT}			μs

Switching Time Waveforms



TL/F/5817–3

FIGURE 1. Shift Timing

Definition of Terms

Vp-p: Output power supply voltage. The return for open-collector relay driver outputs.

t_{BIT}: Period of the incoming clock.

V_{CLK}: The voltage at the clock input.

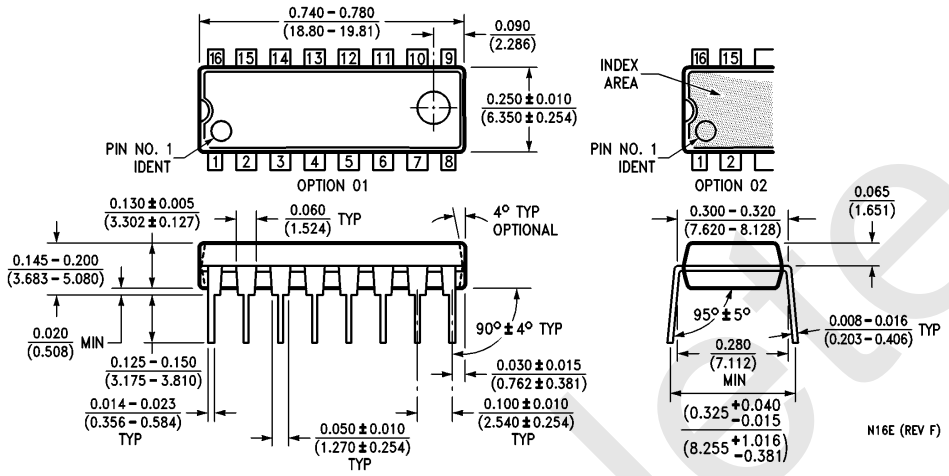
t_{CLK}: The portion of t_{BIT} when $V_{CLK} \geq 2.6V$

$\overline{t_{CLK}}$: The portion of t_{BIT} when $V_{CLK} \leq 0.8V$

$t_{SET\text{-}UP}$: The time prior to the end of $\overline{t_{CLK}}$ required to insure valid data at the shift register input for subsequent clock transitions.

t_{HOLD}: The time following the start of t_{CLK} required to transfer data within the shift register.

Physical Dimensions inches (millimeters)



Molded Dual-In-Line Package (N)
Order Number DS3654N
NS Package Number N16E

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Mobile Processors	www.ti.com/omap		
Wireless Connectivity	www.ti.com/wirelessconnectivity		
	TI E2E Community Home Page		e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265