National Semiconductor

MICROCIRCUIT DATA SHEET

MNSCAN18245T-X REV 1A0

Original Creation Date: 10/23/98
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SERIALLY CONTROLLED ACCESS NETWORK NON-INVERTING TRANSCEIVER WITH TRI-STATE OUTPUTS

General Description

The SCAN18245T is a high speed, low-power bidirectional line driver featuring separate data inputs organized into dual 9-bit bytes with byte-oriented output enable and direction control signals. This device is compliant with IEEE 1149.1 Standard Test Access Port and BOUNDARY-SCAN Architecture with the incorporation of the defined BOUNDARY-SCAN test logic and test access port consisting of Test Data Input (TDI), Test Data Out (TDO), Test Mode Select (TMS), and Test Clock (TCK).

Industry Part Number

SCAN18245T

NS Part Numbers

SCAN18245TFMQB

Prime Die

YJ245

Controlling Document

5962-93115

Processing

MIL-STD-883, Method 5004

Quality Conformance Inspection

MIL-STD-883, Method 5005

Subgrp	Description	Temp (^{o}C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55

Features

- Dual output enable control signals
- TRI-STATE outputs for bus - oriented applications
- 9-bit data busses for parity applications
- Reduced - swing outputs source 24 mA/sink 48 mA.
- Guaranteed to drive 50 Ohm transmission line to TTL input levels of 0.8V and 2.0V.
- TTL compatible inputs
- IEEE 1149.1 (JTAG) Compliant
- Includes CLAMP and HIGH-Z instructions

(Absolute Maximum Ratings)

(Note 1)

Supply Voltage (Vcc)	-0.5V to +7.0V
DC Input Diode Current (Iik)	
Vin = -0.5V	-20 mA
Vin = Vcc +0.5V	+20 mA
DC Output Diode Current (Iok)	
Vo = -0.5V	-20 mA
Vo = Vcc +0.5V	+20 mA
DC Output Voltage (Vo)	-0.5V to Vcc +0.5V
DC Output Source/Sink Current (Io)	±70 mA
DC Vcc or Ground Current per Output Pin	±70 mA
Junction Temperature (Tj)	
Ceramic Flatpack	+175 C
Thermal Resistance (Maximum)	
Junction-To-Case (Theta JC)	5 C/Watt
Junction-To-Ambient (Theta JA) (1 Watt at no airflow)	65 C/Watt
Storage Temperature	-65 C to +150 C
Lead Temperature (Soldering, 10 seconds)	+300 C
ESD Classification	CLASS 3
Maximum Power Dissipation	750 mW

Note 1: Abolute 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 SCAN circuits outside data specifications.

Recommended Operating Conditions

Supply Voltage (Vcc)	4.5V to 5.5V
Input Voltage (Vi)	0V to Vcc
Output Voltage (Vo)	0V to Vcc
Operating Temperature	-55 C to +125 C
Minimum Input Edge Rate (dV/dt)	
Vin from 0.8V to 2.0V	
Vcc @ 4.5V, 5.5V	125 mV/nS
Maximum Output Current	
High Level (IOH)	-24 mA
Low Level (IOL)	48 mA

Electrical Characteristics

DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: 4.5V to 5.5V, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 3 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
IIH	Input HIGH Current	VCC = 5.5V, VIH = 5.5V	1, 3	INPUT		0.1	uA	1
			1, 3	INPUT		0.9	uA	2, 3
IIHR	Input HIGH Current	VCC = 5.5V, VIH = 5.5V	1, 3	TDI/TMS		2.8	uA	1
			1, 3	TDI/TMS		3.7	uA	2, 3
IIL	Input LOW Current	VCC = 5.5V, VIL = 0.0V	1, 3	INPUT		-0.1	uA	1
			1, 3	INPUT		-0.9	uA	2, 3
IILR	Input LOW Current	VCC = 5.5V, VIL = 0.0V	1, 3	TDI/TMS	-160	-385	uA	1, 2, 3
VOL	Output LOW Voltage	VCC=4.5V, IOL=50.0uA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT		.10	V	1, 2, 3
		VCC=5.5V, IOL=50.0uA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT		0.1	V	1, 2, 3
		VCC=4.5V, IOL=48.0mA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT		.55	V	1, 2, 3
		VCC=5.5V, IOL=48.0mA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT		.55	V	1, 2, 3
VIOL	Output LOW Voltage	VCC=5.5V, IOL=63.0mA, VIL=0.0V, VIH=5.5V	1, 3, 5	OUTPUT		0.8	V	1, 2, 3
VOH	Output HIGH Voltage	VCC=4.5V, IOH= -50.0uA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT	3.15		V	1, 2, 3
		VCC=5.5V, IOH= -50.0uA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT	4.15		V	1, 2, 3
		VCC=4.5V, IOH= -24.0mA, VIL=0.8V, VIH=2.0V	1, 3	OUTPUT	2.4		V	1, 2, 3
		VCC=5.5V, IOH= -24.0mA, VIL=0.0V, VIH=2.0V	1, 3	OUTPUT	2.4		V	1, 2, 3
VIOH	Output HIGH Voltage	VCC=5.5V, IOH= -27.0mA, VIL=0.0V, VIH=5.5V	1, 3, 5	OUTPUT	2.0		V	1, 2, 3
ICC	Supply Current	VCC=5.5V, VIH=5.5V, TDI/TMS=VCC, VO=High	1, 3	VCC		16	uA	1
			1, 3	VCC		168	uA	2, 3
ICCM (MAX)	Supply Current	VCC=5.5V, VIH=5.5V, TDI/TMS=Gnd, VO=High	1, 3	VCC		750	uA	1
			1, 3	VCC		930	uA	2, 3
ICCT	Supply Current	VCC=5.5V, VINH=3.4V, TDI/TMS=VCC	1, 3	VCC		2.0	mA	1, 2, 3
ICCTR (MAX)	Supply Current	VCC=5.5V, VINH=3.4V, TDI/TMS Pin, Test one with the other floating	1, 3	VCC		2.15	mA	1, 2, 3

Electrical Characteristics

DC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: 4.5V to 5.5V, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 3 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
IOZHT	Output Leakage Current	VCC=4.5V, VM=4.5V, VIH (OE)=2.0V	1, 3	OUTPUT		0.6	uA	1
			1, 3	OUTPUT		11	uA	2, 3
		VCC=5.5V, VM=5.5V, VIH (OE)=2.0V	1, 3	OUTPUT		0.6	uA	1
			1, 3	OUTPUT		11	uA	2, 3
IOZLT	Output Leakage Current	VCC=4.5V, VM=0.0V, VIH (OE)=2.0V	1, 3	OUTPUT		-0.6	uA	1
			1, 3	OUTPUT		-11.0	uA	2, 3
		VCC=5.5V, VM=0.0V, VIH (OE)=2.0V	1, 3	OUTPUT		-0.6	uA	1
			1, 3	OUTPUT		-11.0	uA	2, 3
IOS	Output Short Circuit Current	VCC=5.5V, VOUT=0.0V, VIN=5.5V,	1, 3	OUTPUT		-100	mA	1, 2, 3
VIKL	Clamp Diode Voltage	VCC=4.5V, IKL = -18mA	1, 3	INPUT		-1.2	V	1, 2, 3
VIKH	Clamp Diode Voltage	VCC=4.5V, IKH = 18mA	1, 3	INPUT		5.7	V	1, 2, 3
CIN	Standard Input Pin Capacitance	VCC = 5.0V	6			5	pF	4
CI/O	Input/Output Pin Capacitance	VCC = 5.0V	6			25	pF	4
CPD	Power Dissipation Capacitance	VCC = 5.0V	6			45	pF	4
VILD	Maximum LOW Dynamic Input Voltage Level	VCC=5.0V, LOAD: 50pF / 500 OHMS	6, 9	INPUT	0.8		V	4
VIHD	Maximum HIGH Dynamic Input Voltage Level	VCC=5.0V, LOAD: 50pF / 500 OHMS	6, 9	INPUT		2.0	V	4
VOLP	Maximum HIGH Output Noise	VCC=5.0V, LOAD: 50pF / 500 OHMS	6, 8	OUTPUT		0.8	V	4
VOLV	Maximum LOW Output Noise	VCC=5.0V, LOAD: 50pF / 500 OHMS	6, 8	OUTPUT		-0.8	V	4
VOHP	Maximum Overshoot	VCC=5.0V, LOAD: 50pF / 500 OHMS	6, 8	OUTPUT		VOH + 0.8	V	4
VOHV	Maximum Vcc Droop	VCC=5.0V, LOAD: 50pF / 500 OHMS	6, 8	OUTPUT		VOH - 0.8	V	4

Electrical Characteristics

AC Parameters: NORMAL OPERATION

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpLH	Propagation Delay	VCC=4.5V	2, 4, 7	A to B, B to A	1.6	9.0	nS	9
			2, 4, 7	A to B, B to A	1.6	10.0	nS	10, 11
tpHL	Propagation Delay	VCC=4.5V	2, 4, 7	A to B, B to A	1.6	9.0	nS	9
			2, 4, 7	A to B, B to A	1.6	11.0	nS	10, 11
tpZH	Enable Time	VCC=4.5V	2, 4, 7	$\overline{OE}$ to A/B	1.6	9.5	nS	9
			2, 4, 7	$\overline{OE}$ to A/B	1.6	11.0	nS	10, 11
tpZL	Enable Time	VCC=4.5V	2, 4, 7	$\overline{OE}$ to A/B	1.6	11.0	nS	9
			2, 4, 7	$\overline{OE}$ to A/B	1.6	13.0	nS	10, 11
tpHZ	Disable Time	VCC=4.5V	2, 4, 7	$\overline{OE}$ to Qn	1.2	8.5	nS	9
			2, 4, 7	$\overline{OE}$ to Qn	1.2	9.5	nS	10, 11
tpLZ	Disable Time	VCC=4.5V	2, 4, 7	$\overline{OE}$ to Qn	1.2	8.6	nS	9
			2, 4, 7	$\overline{OE}$ to Qn	1.2	10.0	nS	10, 11
TOSHL	HL Data to Output	VCC=4.5V	6	Pin to Pin Skew		1.0	nS	9, 10, 11
TOSLH	LH Data to Output	VCC=4.5V	6	Pin to Pin Skew		1.0	nS	9, 10, 11

AC Parameters: SCAN TEST OPERATION

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

tpLH(1)	Propagation Delay	VCC=4.5V	2, 4, 7	TCK to TDO	2.8	13.2	nS	9
			2, 4, 7	TCK to TDO	2.8	15.8	nS	10, 11

Electrical Characteristics

AC Parameters: SCAN TEST OPERATION(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpHL(1)	Propagation Delay	VCC=4.5V	2, 4, 7	TCK to TDO	2.8	13.2	nS	9
			2, 4, 7	TCK to TDO	2.8	15.8	nS	10, 11
tpZH(1)	Enable Time	VCC=4.5V	2, 4, 7	TCK to TDO	2.4	14.5	nS	9
			2, 4, 7	TCK to TDO	2.4	16.7	nS	10, 11
tpZL(1)	Enable Time	VCC=4.5V	2, 4, 7	TCK to TDO	2.4	14.5	nS	9
			2, 4, 7	TCK to TDO	2.4	16.7	nS	10, 11
tpHZ(1)	Disable Time	VCC=4.5V	2, 4, 7	TCK to TDO	2.0	11.5	nS	9
			2, 4, 7	TCK to TDO	2.0	12.8	nS	10, 11
tpLZ(1)	Disable Time	VCC=4.5V	2, 4, 7	TCK to TDO	2.0	11.5	nS	9
			2, 4, 7	TCK to TDO	2.0	12.8	nS	10, 11
tpLH(2)	Propagation Delay	VCC=4.5V During Update-DR state	2, 4, 7	TCK to Data Out	4.0	18.0	nS	9
			2, 4, 7	TCK to Data Out	4.0	21.7	nS	10, 11
tpHL(2)	Propagation Delay	VCC=4.5V During Update-DR state	2, 4, 7	TCK to Data Out	4.0	18.0	nS	9
			2, 4, 7	TCK to Data Out	4.0	21.7	nS	10, 11
tpLH(3)	Propagation Delay	VCC=4.5V During Update-IR state	2, 4, 7	TCK to Data Out	4.0	18.6	nS	9
			2, 4, 7	TCK to Data Out	4.0	21.2	nS	10, 11

Electrical Characteristics

AC Parameters: SCAN TEST OPERATION(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpHL(3)	Propagation Delay	VCC=4.5V During Update-IR state	2, 4, 7	TCK to Data Out	4.0	18.6	nS	9
			2, 4, 7	TCK to Data Out	4.0	21.2	nS	10, 11
tpLH(4)	Propagation Delay	VCC=4.5V During Test Logic Reset	2, 4, 7	TCK to Data Out	4.4	19.9	nS	9
			2, 4, 7	TCK to Data Out	4.4	23.0	nS	10, 11
tpHL(4)	Propagation Delay	VCC=4.5V During Test Logic Reset	2, 4, 7	TCK to Data Out	4.4	19.9	nS	9
			2, 4, 7	TCK to Data Out	4.4	23.0	nS	10, 11
tpLZ(2)	Disable Time	VCC=4.5V During Update-DR state	2, 4, 7	TCK to Data Out	3.2	16.4	nS	9
			2, 4, 7	TCK to Data Out	3.2	19.6	nS	10, 11
tpHZ(2)	Disable Time	VCC=4.5V During Update-DR state	2, 4, 7	TCK to Data Out	3.2	16.4	nS	9
			2, 4, 7	TCK to Data Out	3.2	19.6	nS	10, 11
tpLZ(3)	Disable Time	VCC=4.5V During Update-IR state	2, 4, 7	TCK to Data Out	2.8	18.0	nS	9
			2, 4, 7	TCK to Data Out	2.8	20.9	nS	10, 11
tpHZ(3)	Disable Time	VCC=4.5V During Update-IR state	2, 4, 7	TCK to Data Out	2.8	18.0	nS	9
			2, 4, 7	TCK to Data Out	2.8	20.9	nS	10, 11

Electrical Characteristics

AC Parameters: SCAN TEST OPERATION(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpLZ(4)	Disable Time	VCC=4.5V During Test Logic Reset	2, 4, 7	TCK to Data Out	2.8	18.4	nS	9
			2, 4, 7	TCK to Data Out	2.8	21.8	nS	10, 11
tpHZ(4)	Disable Time	VCC=4.5V During Test Logic Reset	2, 4, 7	TCK to Data Out	2.8	18.4	nS	9
			2, 4, 7	TCK to Data Out	2.8	21.8	nS	10, 11
tpZL(2)	Enable Time	VCC=4.5V During Update-DR state	2, 4, 7	TCK to Data Out	4.0	18.9	nS	9
			2, 4, 7	TCK to Data Out	4.0	22.6	nS	10, 11
tpZH(2)	Enable Time	VCC=4.5V During Update-DR state	2, 4, 7	TCK to Data Out	4.0	18.9	nS	9
			2, 4, 7	TCK to Data Out	4.0	22.6	nS	10, 11
tpZL(3)	Enable Time	VCC=4.5V During Update-IR state	2, 4, 7	TCK to Data Out	3.2	19.9	nS	9
			2, 4, 7	TCK to Data Out	3.2	23.7	nS	10, 11
tpZH(3)	Enable Time	VCC=4.5V During Update-IR state	2, 4, 7	TCK to Data Out	3.2	19.9	nS	9
			2, 4, 7	TCK to Data Out	3.2	23.7	nS	10, 11
tpZL(4)	Enable Time	VCC=4.5V During Test Logic Reset	2, 4, 7	TCK to Data Out	3.6	21.3	nS	9
			2, 4, 7	TCK to Data Out	3.6	24.9	nS	10, 11

Electrical Characteristics

AC Parameters: SCAN TEST OPERATION(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpZH(4)	Enable Time	VCC=4.5V During Test Logic Reset	2, 4, 7	TCK to Data Out	3.6	21.3	nS	9
			2, 4, 7	TCK to Data Out	3.6	24.9	nS	10, 11
Tset (L/H) (1)	Setup Time	VCC=4.5V	6	Data to TCK	0.0		nS	9, 10, 11
Thold(L/H) (1)	Hold Time	VCC=4.5V	6	TCK to Data	6.5		nS	9, 10, 11
Tset (L/H) (2)	Setup Time	VCC=4.5V	6	$\overline{G1}$, $\overline{G2}$ to TCK	0.0		nS	9, 10, 11
Thold(L/H) (2)	Hold Time	VCC=4.5V	6	TCK to $\overline{G1}$, $\overline{G2}$	4.0		nS	9, 10, 11
Tset (L/H) (3)	Setup Time	VCC=4.5V Internal OE to TCK	6		1.0		nS	9, 10, 11
Thold(L/H) (3)	Hold Time	VCC=4.5V TCK to Internal OE	6		4.0		nS	9, 10, 11
Tset (L/H) (4)	Setup Time	VCC=4.5V	6	DIR1/ DIR2 to TCK	0.0		nS	9, 10, 11
Thold(L/H) (4)	Hold Time	VCC=4.5V	6	TCK to DIR1/ DIR2	4.0		nS	9, 10, 11
Tset (L/H) (5)	Setup Time	VCC=4.5V	6	TMS to TCK	7.0		nS	9, 10, 11
Thold(L/H) (5)	Hold Time	VCC=4.5V	6	TCK to TMS	2.0		nS	9, 10, 11
Tset (L/H) (6)	Setup Time	VCC=4.5V	6	TDI to TCK	1.0		nS	9, 10, 11
Thold(L/H) (6)	Hold Time	VCC=4.5V	6	TCK to TDI	3.5		nS	9, 10, 11
tw (H)	Pulse Width HIGH	VCC=4.5V	6	TCK (H)	12.0		nS	9, 10, 11
tw (L)	Pulse Width LOW	VCC=4.5V	6	TCK (L)	5.0		nS	9, 10, 11
Fmax	Maximum Clock Frequency	VCC=4.5V	6	TCK	25		Mhz	9, 10, 11
Tpu	Wait Time, Power Up to TCK	VCC=4.5V	6			100	nS	9, 10, 11

Electrical Characteristics

AC Parameters: SCAN TEST OPERATION(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pF, RL=500 Ohms, TRISE/TFALL = 3.0nS, Temp. Range: -55 C to 125 C. NOTE: -55C TEMPERATURE, SUBGROUP 11 IS GUARANTEED BUT NOT TESTED.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Tpd	Power Down Delay	VCC=0.0V	6			100	mS	9, 10, 11

Note 1: SCREEN TESTED 100% ON EACH DEVICE AT +25 C & +125 C TEMPERATURE, SUBGROUPS 1, 2, 7 & 8.
Note 2: SCREEN TESTED 100% ON EACH DEVICE AT +25 C TEMPERATURE ONLY, SUBGROUP A9.
Note 3: SAMPLE TESTED (METHOD 5005, TABLE I) ON EACH MFG. LOT AT +25 C & +125 C TEMPERATURE, SUBGROUP A1, 2, 7 & 8.
Note 4: SAMPLE TESTED (METHOD 5005, TABLE 1) ON EACH MFG. LOT AT +25 C & +125C TEMPERATURE, SUBGROUPS A9 & 10.
Note 5: TRANSMISSION LINE DRIVING TEST, 2 MSEC DURATION MAX.
Note 6: GUARANTEED BUT NOT TESTED. (DESIGN CHARACTERIZATION DATA ONLY).
Note 7: +25 C & +125 C MIN LIMITS GUARANTEED FOR 5.5V BY GUARDBANDING 4.5V MINIMUM LIMITS.
Note 8: MAX NUMBER OF OUTPUTS DEFINED AT (N). DATA INPUTS ARE DRIVEN 0V to 3V. ONE OUTPUT AT VOL.
Note 9: MAX NUMBER OF DATA INPUTS (N) SWITCHING. (N-1) INPUTS SWITCHING 0V TO 3V. INPUT-UNDER-TEST SWITCHING: 3V TO THRESHOLD(VILD), 0V TO THRESHOLD(VIHD), FREQ = 1MHZ.

Revision History

Rev	ECN #	Rel Date	Originator	Changes
1A0	M0000516	12/11/98	Linda Collins	Initial Release to MDS:: MNSCAN18245T-X Rev. 1A0