CMOS IC Application Note

S-19980/19990 Series
FLYBACK CONVERTER CIRCUIT

Rev.1.0_00

This application note is a reference that explains the flyback converter circuit using the S-19980/19990 Series.
Refer to the datasheet for details and specs.

Contents

1. Overview

S-19980/19990 Series is an automotive step-up switching regulator controller. It can also be used for flyback converter circuits as an application circuit.
This application note shows an example of a flyback converter circuit that generates an isolated power supply from a 12 V power supply for the bias power supply of the inverter gate driver.

2. Specifications

Table 1 Example of Specifications

(V_{IN} = 12 V, Ta = 25°C unless otherwise specified))

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating input voltage	V_{IN}	–	8	12	16	V
Output voltage	V_{OUT1}	–	–	4.7	–	V
Isolated output voltage	V_{OUT_ISO1}	–	–	18	–	V
Output current	I_{OUT1}	–	–	0.1	0.2	A
Isolated output current	I_{OUT_ISO1}	–	–	0.1	0.2	A
Oscillation frequency	f_{OSC}	–	–	400	–	kHz
Transformer characteristics (MinebeaMitsumi Inc. TR11-A-S)						
Primary inductance	Lp	–	–	6.0	–	μH
Turns ratio	Np:N1:N2	–	–	1:0.83:3	–	–
DC resistance Np	R_{DCp}	–	–	50.2	–	mΩ
DC resistance N1	R_{DC1}	–	–	82.8	–	mΩ
DC resistance N2	R_{DC2}	–	–	375	–	mΩ
Saturation current	Isat	–	–	2.2	–	A
Withstand voltage	Vdi	AC, 1 minute	–	–	2000	Vrms
Leakage inductance	L_{LEAK}	Primary side	–	0.07	–	μH

Caution These constants will not guarantee successful operation. Perform thorough evaluation including the temperature characteristics with an actual application to set the constants.

3. Application Circuit

Figure 1 shows the application circuit of "**Table 1 Example of Specifications**".

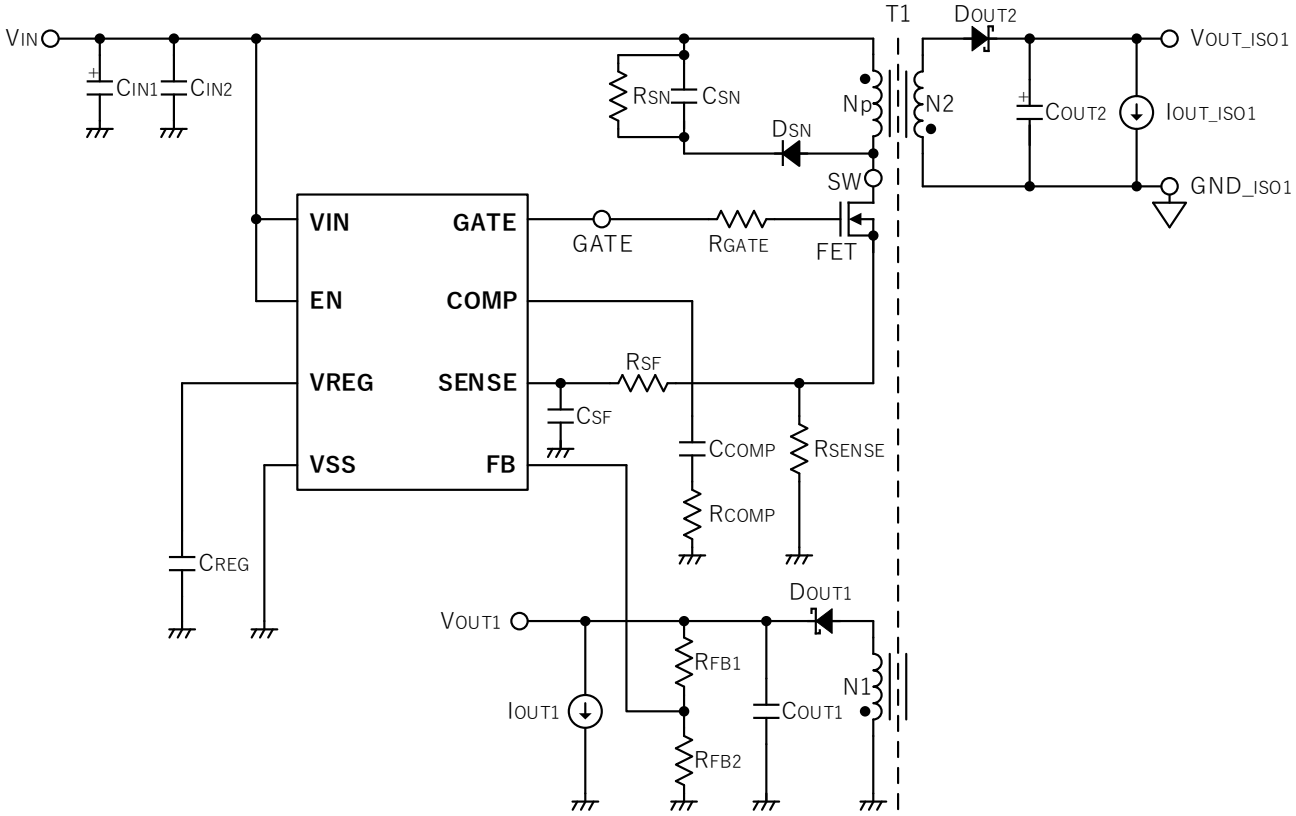
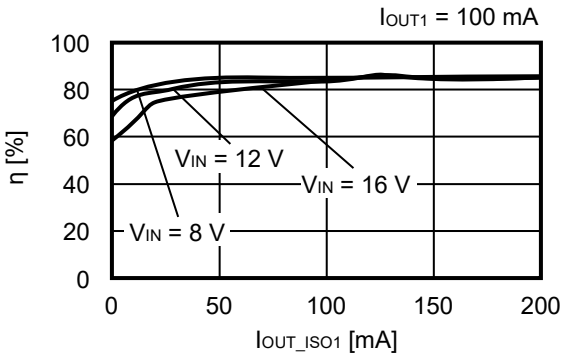


Figure 1

Caution **It has not been confirmed whether the operation is normal or not in circuits other than the connection example. In addition, the connection example and the constants do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constants.**

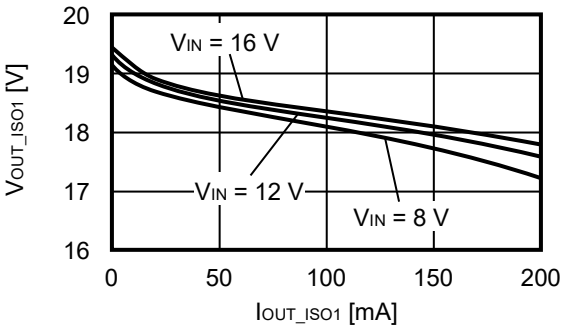
4. Characteristics (Typical Data)

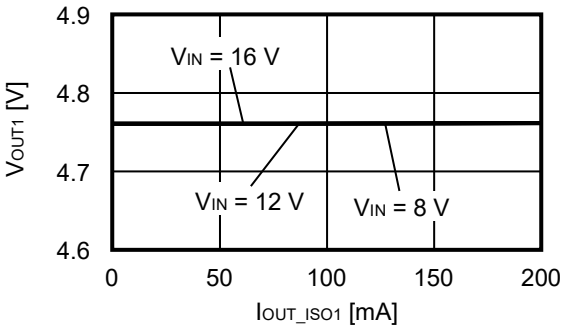
4. 1 Efficiency (η) vs. Output current (I_{OUT_ISO1}) (Ta = +25°C)



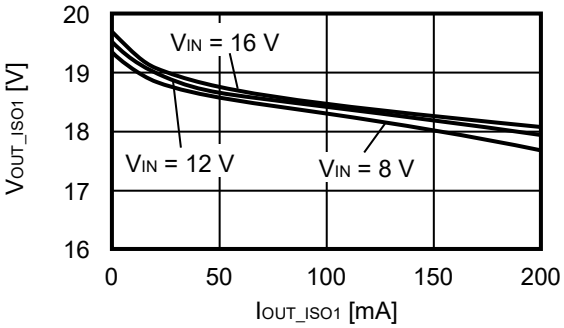
4. 2 Output voltage (V_{OUT}) vs. Output current (I_{OUT_ISO1}) (Ta = +25°C)

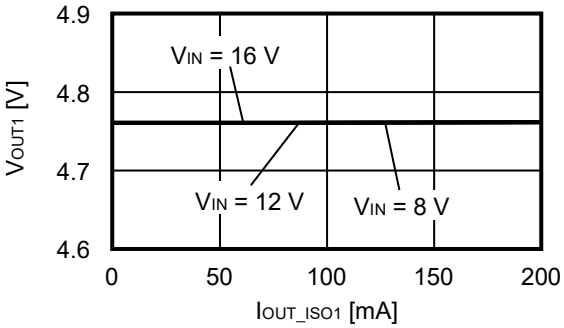
4. 2. 1 I_{OUT1} = 100 mA





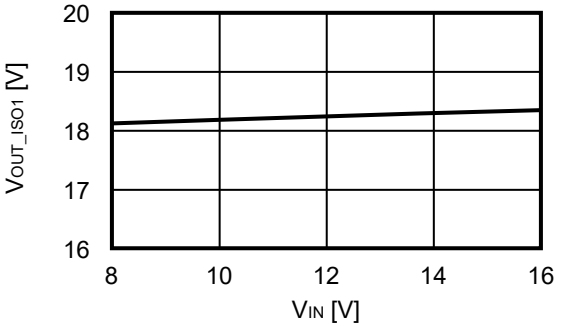
4. 2. 2 I_{OUT1} = 150 mA

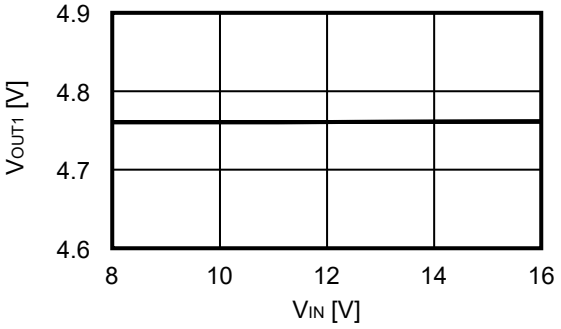




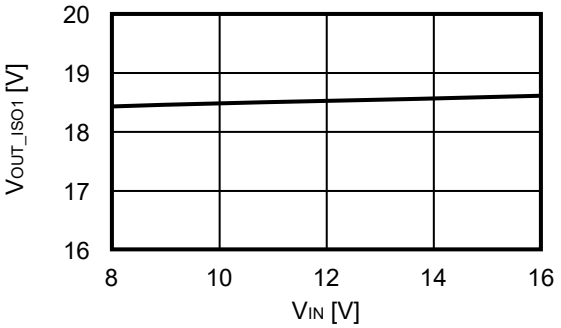
4. 3 Output voltage (V_{OUT}) vs. Input voltage (V_{IN}) (Ta = +25°C)

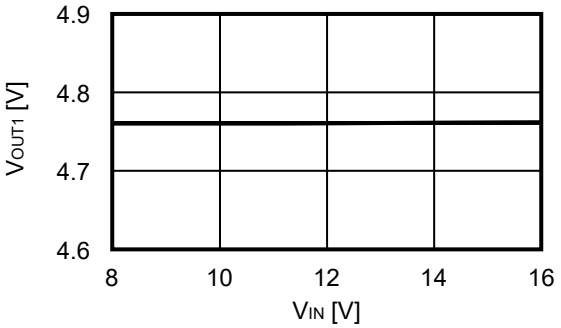
4. 3. 1 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 100 mA





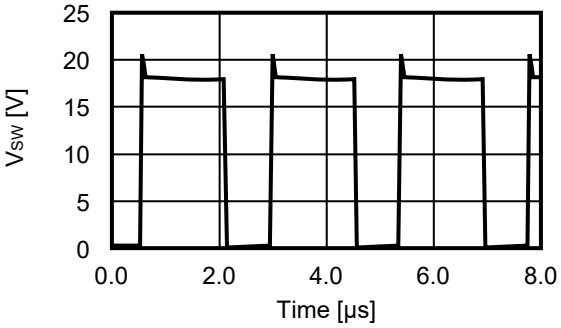
4. 3. 2 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 50 mA

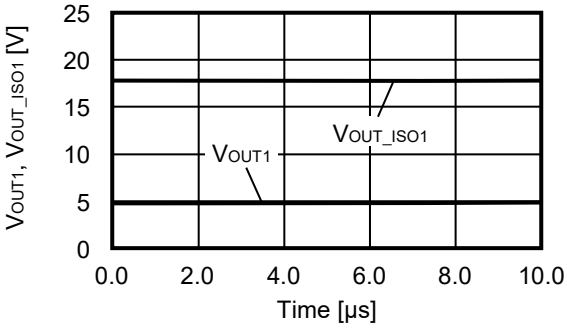




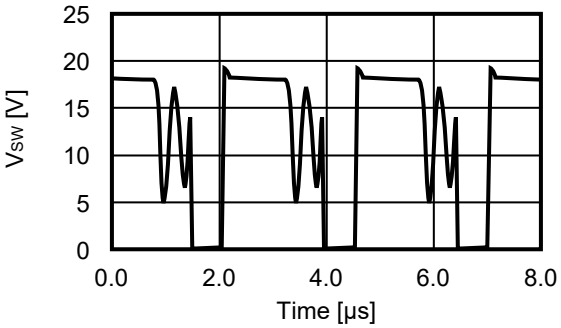
4. 4 Switching waveform (V_{IN} = 12 V, Ta = +25°C)

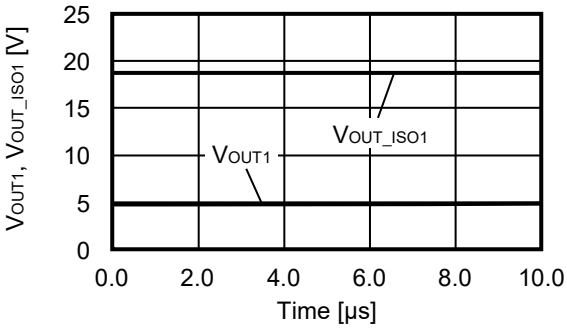
4. 4. 1 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 150 mA





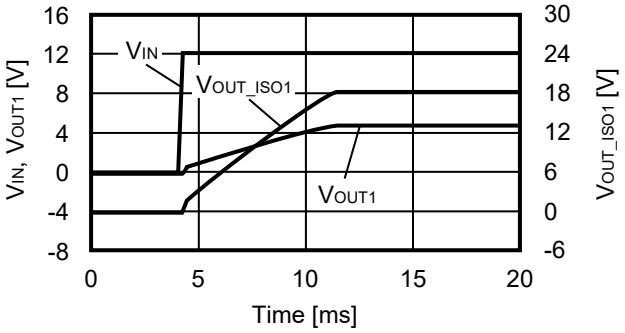
4. 4. 2 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 50 mA



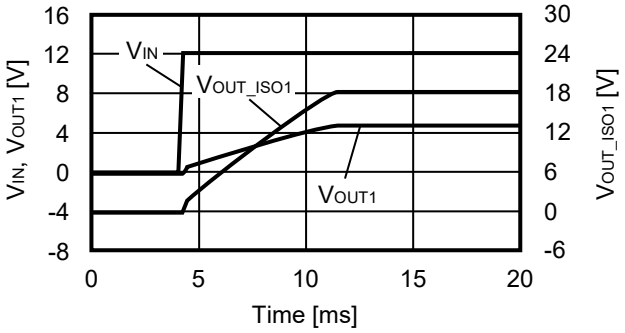


4. 5 Power-on (V_{IN} = 12 V, V_{IN} = V_{EN} = 0 V → 12 V, Ta = +25°C)

4. 5. 1 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 150 mA

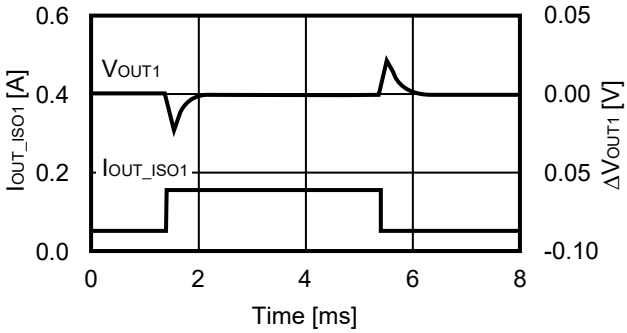


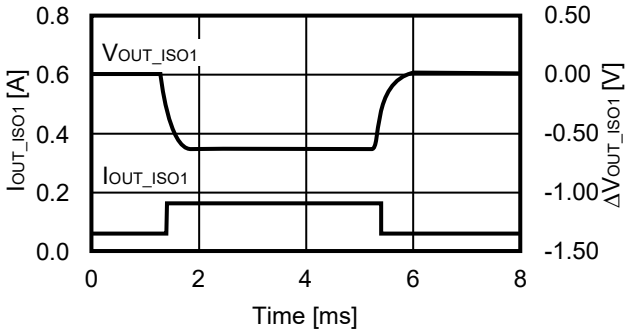
4. 5. 2 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 50 mA



4. 6 Load transient response (V_{IN} = 12 V, Ta = +25°C)

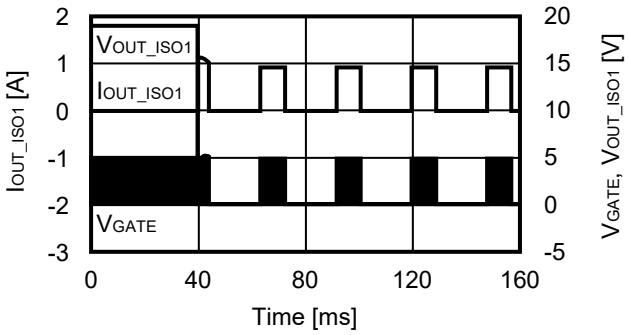
4. 6. 1 I_{OUT1} = 100 mA, I_{OUT_ISO1} = 50 mA ↔ 150 mA





4. 7 Short-circuit protection (V_{IN} = 12 V, Ta = +25°C)

4. 7. 1 Hiccup control



5. Circuit Diagram

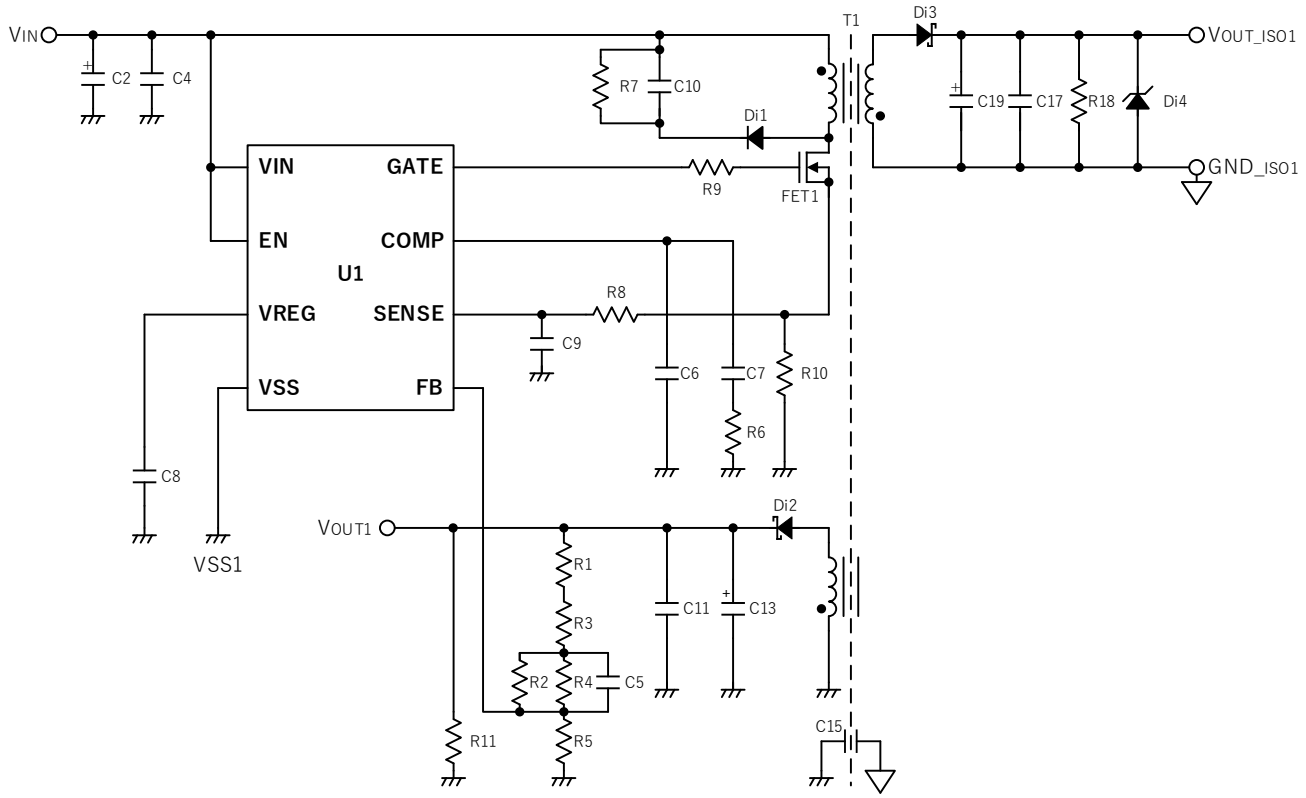


Figure 2 Circuit Diagram of the S-19980/19990 Series Flyback Converter Circuit

Table 2 shows external components used in the circuit diagram: **Figure 2**.

Table 2

Symbol	Value	Part Number	Manufacturer
U1	–	S-19990CA-S8T1U7	ABLIC Inc.
T1	–	TR11-A-S	MinebeaMitsumi Inc.
FET1	–	PMV60EN	Nexperia B.V.
Di1	–	ES1B-13-F	Vishay Intertechnology,Inc.
Di2, Di3	–	SS1P6LHM3	Vishay Intertechnology,Inc.
Di4	User settings	–	–
C2	33 μF	GYC1H330MCQ1GS	NICHICON CORPORATION
C4	0.1 μF	CGA4J2X8R1H104K	TDK Corporation
C5	User settings	–	–
C6	100 pF	CGA3E2NP01H101J	TDK Corporation
C7	4.7 nF	CGA3E2X8R1H472K	TDK Corporation
C8	1 μF	CGA5L3X8R1H105K	TDK Corporation
C9	10 nF	CGA3E2X8R1H103K	TDK Corporation
C10	68 nF	CGA3E2X7R1H683K	TDK Corporation
C11	User settings	–	–
C13, C19	33 μF	GYC1H330MCQ1GS	NICHICON CORPORATION
C15	1000 pF	1812GC102KAT1A	KYOCERA AVX Components Corporation
C17	User settings	–	–
R1	0 Ω	MCR3 series (1608)	ROHM CO., LTD.
R2	User settings	–	–
R3	3.9 kΩ	MCR3 series (1608)	ROHM CO., LTD.
R4	75 kΩ	MCR3 series (1608)	ROHM CO., LTD.
R5	16 kΩ	MCR3 series (1608)	ROHM CO., LTD.
R6	10 kΩ	MCR3 series (1608)	ROHM CO., LTD.
R7	15 kΩ	MCR3 series (6243)	ROHM CO., LTD.
R8	22 Ω	MCR3 series (1608)	ROHM CO., LTD.
R9	10 Ω	MCR3 series (1608)	ROHM CO., LTD.
R10	50 mΩ	ERJMB1SF50MU	Panasonic Industry Co., Ltd.
R11	User settings	–	–
R18	1 kΩ	MCR50 series (5025)	ROHM CO., LTD.

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2. It has not been confirmed whether the operation is normal or not in circuits other than the connection example. In addition, the connection example and the constants do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constants.

6. Precautions

- The usages described in this application note are typical examples using ICs of ABLIC Inc.
  Perform thorough evaluation before use.

- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

- ABLIC Inc. claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

7. Related Sources

Refer to the following datasheet for details of the S-19980/19990 Series.

S-19980 Series Datasheet
S-19990 Series Datasheet

The information described in this application note and the datasheet is subject to change without notice.
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