MN3113F

Vertical Driver LSI for Video Camera CCD Area Image Sensor

■ Overview

The MN3113F is a vertical driver LSI for a two-dimensional interline CCD image sensor. It features a built-in power supply circuit that, in conjunction with such external components as six booster capacitors and two voltage stabilization capacitors, produces stabilized +15.0V and –10.0V power supplies from a +5.0V input and HD pulses.

The MN3113F makes it possible to drive a CCD image sensor on a single 5 volt power supply.

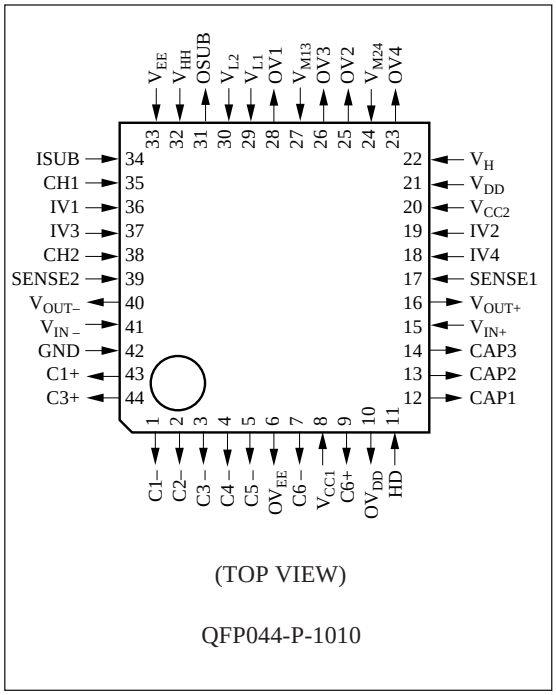
■ Features

- Single 5 volt power supply
- Adjustable output voltage for regulated voltage circuit

■ Applications

- Video cameras

■ Pin Assignment



(TOP VIEW)

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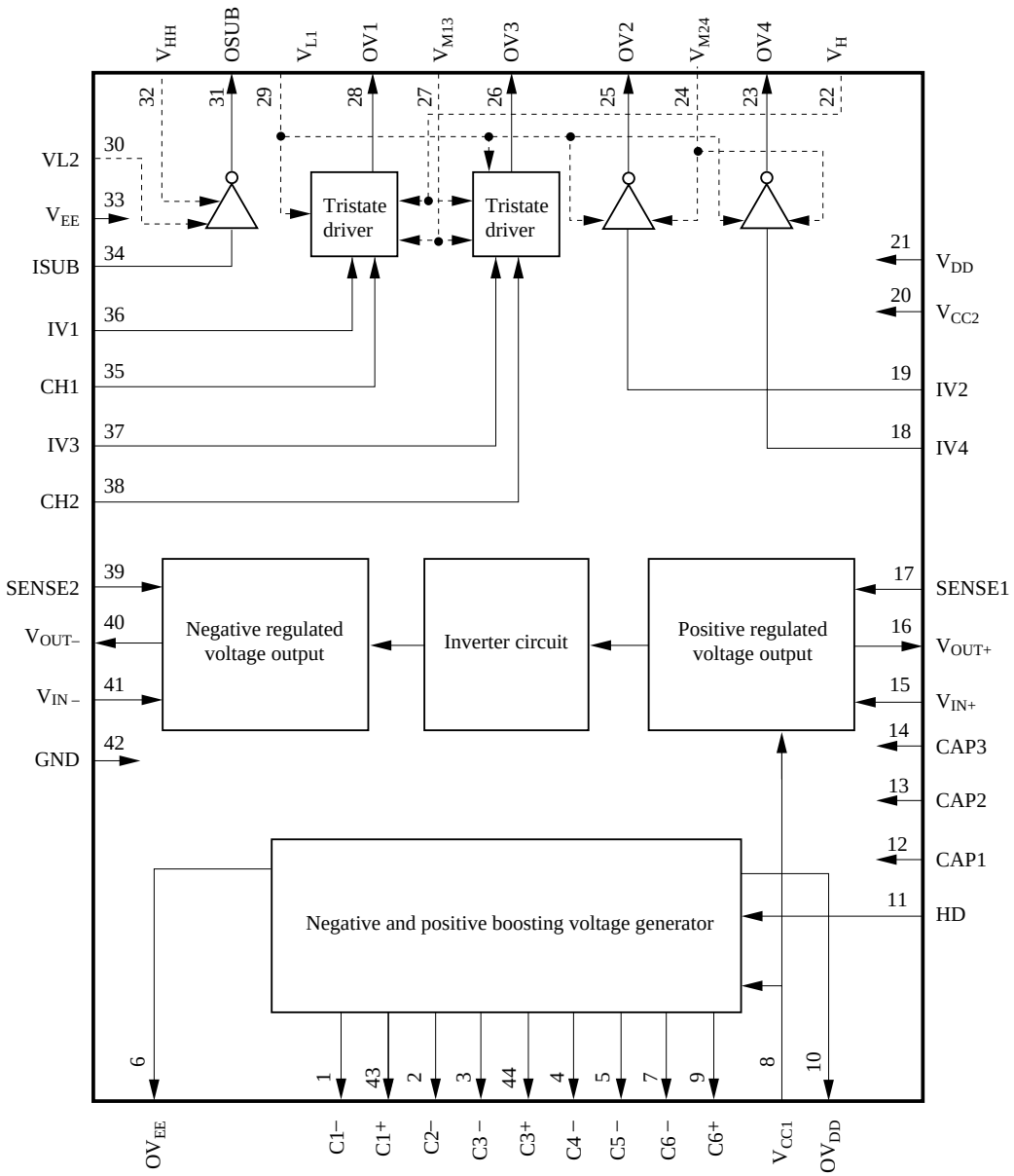
■ Block Diagram



■ Pin Descriptions

Pin No.	Symbol	Pin Name	I/O	Function Description
8 20	V_{CC1} V_{CC2}	"H" level power supply for input block	I	"H" level input for 5 volt circuits
42	GND	"L" level power supply for input block	I	"L" level input for 5 volt circuits
22	V_H	"H" level power supply for vertical driver	I	"H" level input for high-voltage circuits
32	V_{HH}	"H" level power supply for SUB driver	I	"H" level input for high-voltage circuits
27 24	V_{M13} V_{M24}	"M" level power supply for vertical driver	I	"M" level input for high-voltage circuits
29	V_{L1}	"L" level power supply for vertical driver	I	"L" level input for high-voltage circuits
30	V_{L2}	"L" level input for SUB driver	I	"L" level input for high-voltage circuits
21	V_{DD}	Power supply 1 for driver	I	"H" level for high-voltage circuits
33	V_{EE}	Power supply 2 for driver	I	"L" level for high-voltage circuits
15	V_{IN+}	Positive regulated voltage block voltage input	I	Positive regulated voltage block voltage input pin
41	V_{IN-}	Negative regulated voltage block voltage input	I	Negative regulated voltage block voltage input pin
11	HD	HD pulse input	I	HD pulse input pin
19	IV2	Transfer pulse input	I	Charge transfer pulse input pin
18	IV4	Transfer pulse input	I	Charge transfer pulse input pin
36	IV1	Transfer pulse input	I	Charge transfer pulse input pin
37	IV3	Transfer pulse input	I	Charge transfer pulse input pin
35	CH1	Charge pulse input	I	Charge readout pulse input pin
38	CH2	Charge pulse input	I	Charge readout pulse input pin
34	ISUB	SUB pulse input	I	Unwanted charge rejection pulse input pin
17	SENSE1	Positive voltage sensing input	I	Positive voltage control sensing pin
39	SENSE2	Negative voltage sensing input	I	Negative voltage control sensing pin
43 1	C1+ C1–	C1 connection	O	Booster block voltage charging capacitor connection pins
2	C2+ C2–	C2 connection	O	Booster block voltage charging capacitor connection pins
44 3	C3+ C3 –	C3 connection	O	Booster block voltage charging capacitor connection pins
4	C4 –	C4 connection	O	Booster block voltage charging capacitor connection pins
5	C5 –	C5 connection	O	Booster block voltage charging capacitor connection pins

■ Pin Descriptions (continued)

Pin No.	Symbol	Pin Name	I/O	Function Description
7 9	C6 – C6+	C6 connection pins	O	Booster block voltage charging capacitor connection pins
10	OV_{DD}	Booster block positive voltage output	O	Booster block positive voltage output pin
6	OV_{EE}	Booster block negative voltage output	O	Booster block negative voltage output pin
16	V_{OUT+}	Positive regulated voltage output	O	Positive regulated voltage output pin
40	V_{OUT-}	Negative regulated voltage output	O	Negative regulated voltage output pin
23	OV4	Binary transfer pulse output	O	Binary (V_{M24}, V_{L1}) transfer pulse output pin
25	OV2	Binary transfer pulse output	O	Binary (V_{M24}, V_{L1}) transfer pulse output pin
26	OV3	Tristate transfer pulse output	O	Tristate (V_H, V_{M13}, V_{L1}) transfer pulse output pin
28	OV1	Tristate transfer pulse output	O	Tristate (V_H, V_{M13}, V_{L1}) transfer pulse output pin
31	OSUB	SUB pulse output	O	Unwanted charge (V_{HH}, V_{L2}) rejection pulse input pin
12 13 14	CAP1 CAP2 CAP3	Stabilizing capacitor connection	O	Pins for connecting capacitors for internal voltage stabilization circuits

■ Functional Description

Binary transfer pulses (vertical driver block)

IV2 IV4	OV2 OV4
H	L
L	M

Tristate transfer pulses (vertical driver block)

CH1 CH2	IV1 IV3	OV1 OV3
H	H	L
	L	M
L	H	L
	L	H

*1 IV1, IV2, IV3, IV4, CH1, CH2

H: V_{CC}

L: GND

OV1, OV2, OV3, OV4

H: V_H

M: V_{M13} , or V_{M24}

L: V_{L1}

Unwanted charge rejection pulses (SUB driver block)

ISUB	OSUB
H	L
L	H

*1 ISUB

H: V_{CC}

L: GND

OSUB

H: V_{HH}

L: V_{L2}

■ Electrical Characteristics

(1) DC characteristics

$V_{HH}=V_H=15.0V$, $V_{M13}=V_{M24}=1.0V$, GND=0.0V ,

$V_{CC1}=V_{CC2}=5.0V$ ($=V_{CC}$), $V_{L1}=-7.0V$, $V_{L2}=-10.0V$, Ta=+25˚C

Parameter	Symbol	Test conditions	min	typ	max	Unit
Quiescent supply current	I_{DDST}	V_I=GND , V_{CC}		2	4	mA
Operating supply current	I_{DDDYN}	V_I=GND , V_{CC}		45	90	mA
Power supply output pins	OV_{DD} , OV_{EE}					
Positive voltage stabilization circuit output voltage	V_{OUT+}	V_I=GND , V_{CC} , I_O=7mA f_{INHD}=15.7kHz	14.5	15.0	15.5	V
Negative voltage stabilization circuit output voltage	V_{OUT-}	V_I=GND , V_{CC} , I_O=–2mA f_{INHD}=15.7kHz	–10.5	–10.0	–9.5	V
Input pins	IV1 , IV2 , IV3 , IV4 , CH1 , CH2 , ISUB , HD					
"H" level voltage	V_{IH}		3.5		V_{CC}	V
"L" level voltage	V_{IL}		GND		1.5	V
Input leak current	I_{LI}	V_I=0 to 5V			±1	µA
Output pins 1 (Binary output)	OV2 , OV4					
Output voltage "M" level	V_{OM1}	V_I=GND , V_{CC} , I_{OM1}=–1mA	0.9		V_{M24}	V
Output voltage "L" level	V_{OL1}	V_I=GND , V_{CC} , I_{OL1}=1mA	V_{L1}		–6.9	V
Output on resistance "M" level	R_{ONM1}	I_{OM1}=–50mA			40	Ω
Output on resistance "L" level	R_{ONL1}	I_{OL1}=50mA			40	Ω
Output pins 2 (Tristate output)	OV1 , OV3					
Output voltage "H" level	V_{OH2}	V_I=GND , V_{CC} , I_{OH2}=–1mA	14.9		V_H	V
Output voltage "M" level	V_{OM2}	V_I=GND , V_{CC} , I_{OM2}=–1mA	0.9		V_{M13}	V
Output voltage "L" level	V_{OL2}	V_I=GND , V_{CC} , I_{OL2}=1mA	V_{L1}		–6.9	V
Output on resistance "H" level	R_{ONH2}	I_{OH2}=–50mA			50	Ω
Output on resistance "M" level	R_{ONM2}	I_{OM2}=±50mA			40	Ω
Output on resistance "L" level	R_{ONL2}	I_{OL2}=50mA			40	Ω
Output pin 3 (SUB output)	OSUB					
Output voltage "H" level	V_{OHH3}	V_I=GND , V_{CC} , I_{OHH3}=–1mA	14.9		V_{HH}	V
Output voltage "L" level	V_{OL3}	V_I=GND , V_{CC} , I_{OL3}=1mA	V_{L2}		–9.9	V
Output on resistance "H" level	R_{ONHH3}	I_{ONHH3}=–50mA			50	Ω
Output on resistance "L" level	R_{ONL3}	I_{ONL3}=50mA			40	Ω

(2) AC characteristics

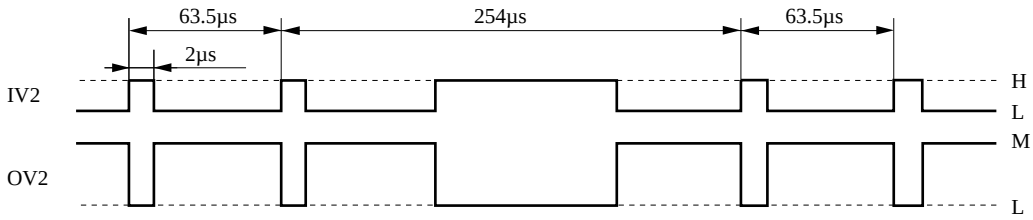
$V_{HH}=V_H=15.0V$, $V_{M13}=V_{M24}=1.0V$, GND=0.0V ,

$V_{CC1}=V_{CC2}=5.0V$ ($=V_{CC}$) , $V_{L1}=-7.0V$, $V_{L2}=-10.0V$, Ta=+25˚C

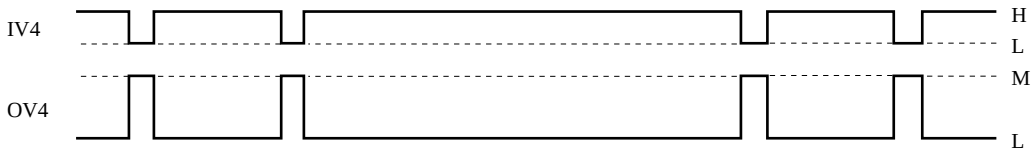
Parameter	Symbol	Test Conditions	min	typ	max	Unit
Output pins 1 (Binary output)	OV2 , OV4					
Transmission delay time	t_{PLM}	No load		100	200	ns
	t_{PML}	From "L" level to "M" level				
Rise time	t_{TLM}			200	300	ns
Fall time	t_{TML}					
Output pins 2 (Tristate output)	OV1 , OV3					
Transmission delay time	t_{PLM}	No load		100	200	ns
	t_{PML}	From "L" level to "M" level				
Transmission delay time	t_{PMH}	No load		200	400	ns
	t_{PHM}	From "M" level to "H" level				
Rise time	t_{TLM}			200	300	ns
Fall time	t_{TML}					
Rise time	t_{TMH}			200	300	ns
Fall time	t_{THM}					
Output pin 3 (SUB output)	OSUB					
Transmission delay time	t_{PLHH}	No load		100	200	ns
	t_{PHHL}	From "L" level to "H" level				
Risie time	t_{TLHH}			200	300	ns
Fall time	t_{THHL}					

■ Timing Chart

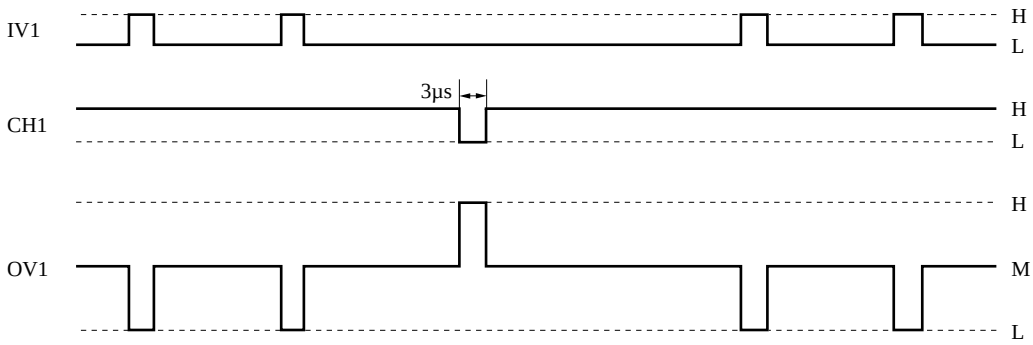
1. Binary transfer pulses



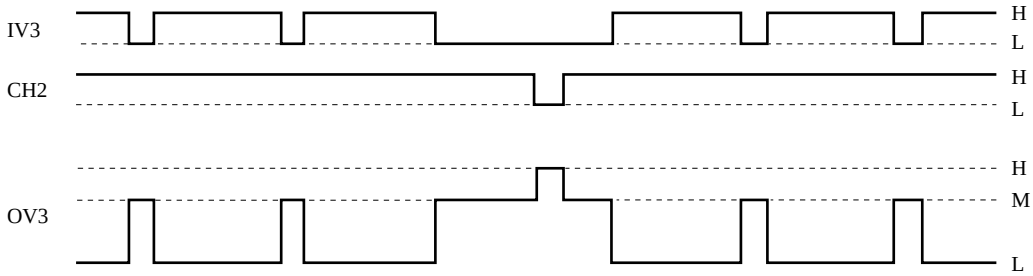
2. Binary transfer pulses



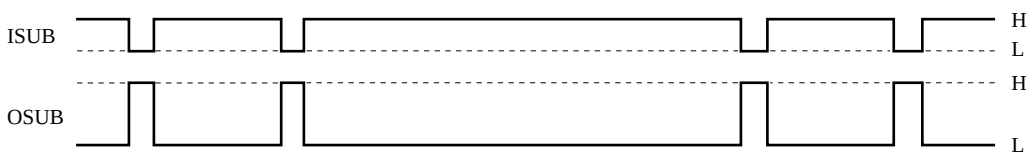
3. Tristate transfer pulses



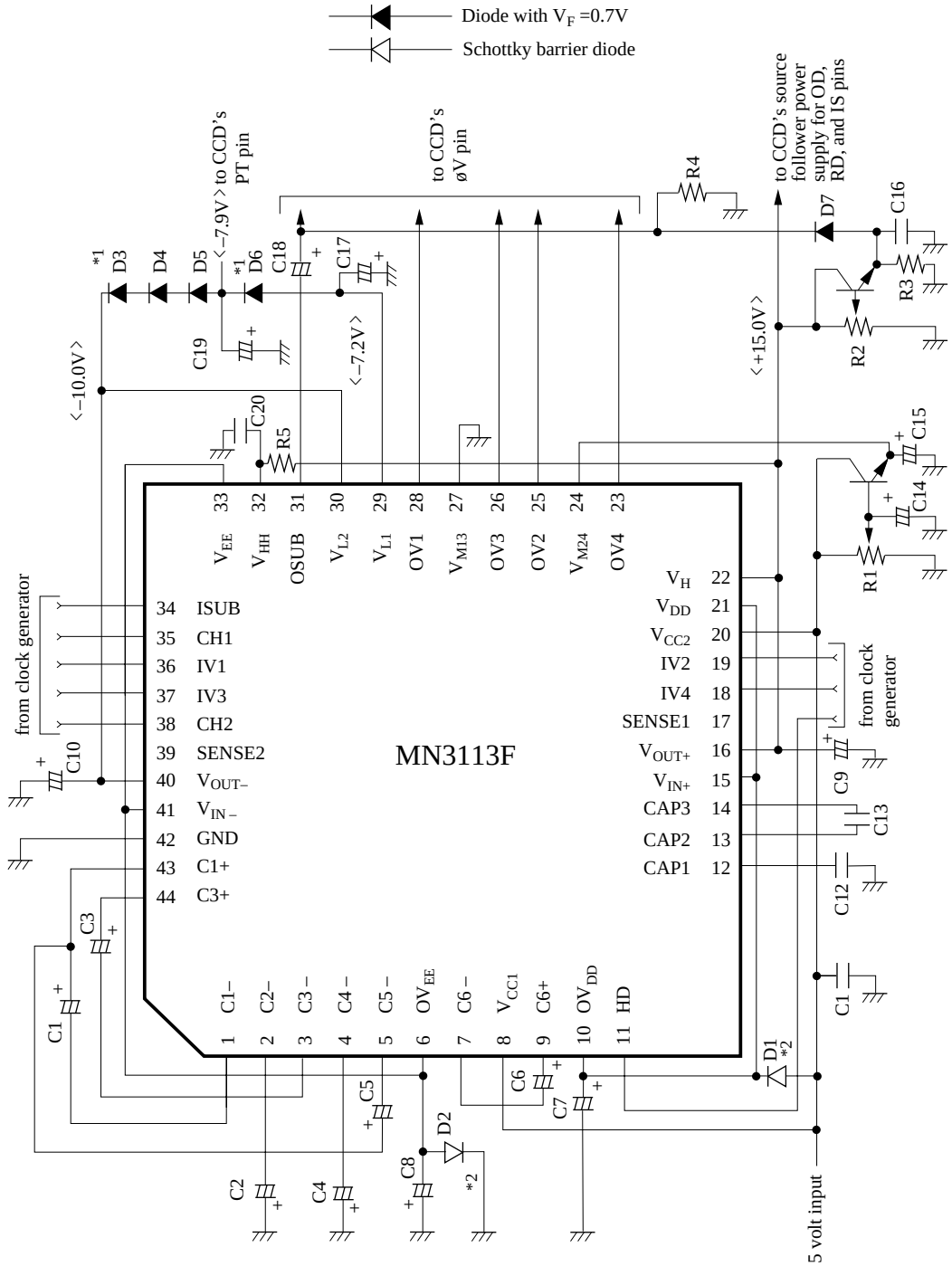
4. Tristate transfer pulses



5. SUB pulses



■ Application Circuit Example



Notes

*1: These diodes must have a V_F of 0.7V.

*2: These diodes must be Schottky barrier diodes (MA723).

*3: The booster circuit's electrolytic capacitors (C1 to C8) and voltage stabilization capacitors (C9 and C10) must have little impedance fluctuation at low temperatures.

■ Package Dimensions (Unit: mm)

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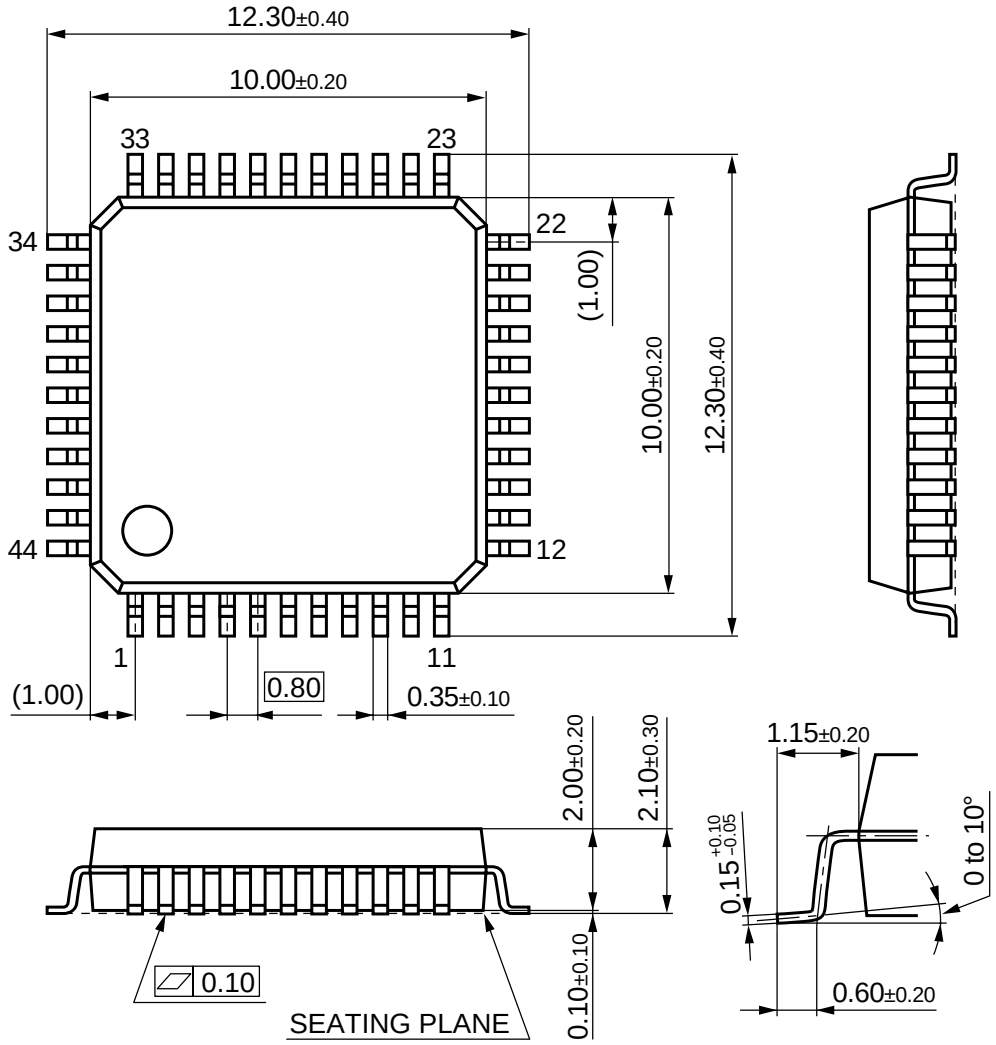


■ Usage Notes

External components

1. This product requires two Schottky barrier diodes.

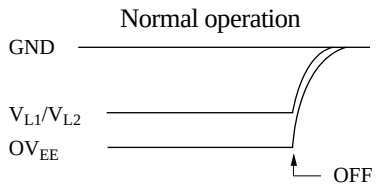
   We recommend the following components.

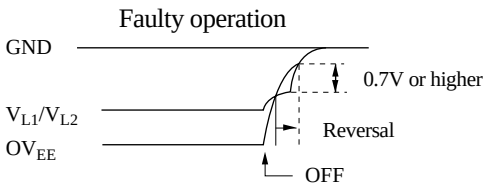
   Schottky barrier diodes: MA723 or equivalents

Ta=25˚C

Component	Model number	Typical characteristics	Notes
Schottky barrier diodes	MA723	I_F =200mA, $V_F \leq 0.55$V	

The MN3113F will not operate properly if the components do not satisfy the above specifications.





2. Always use the specified components for peripheral circuits so as to ensure that OV_{EE} and V_L do not reverse potentials when the power is turned off.

   As the above sketch illustrates, allowing OV_{EE} to exceed V_{L1} and V_{L2} by more than 0.7 V produces the risk of applying a forward bias to the PN junction, turning on the parasitic transistor, and generating an overcurrent that produces latch-up.

   If this phenomenon arises, increase the size of capacitor C8 or decrease the size of capacitor C10 to increase the OV_{EE} time constant.

   (See the sample application circuit for the locations of C8 and C10.)

3. Adjusting boost voltages with SENSE pins

The MN3113F provides the SENSE pins, SENSE1 and SENSE2, for adjusting the boost voltages (V_{OUT+} and V_{OUT-}) with the following procedures.

Adjusting the positive boosted voltage

(1) Making $V_{OUT+} < 15V$

Insert a resistor, R, between the SENSE1 pin (pin 17) and the V_{OUT+} pin (pin 16). The theoretical output voltage at the V_{OUT+} pin is then given by the following formula.

$$V_{OUT+'} = V_{CC} \times \frac{50k\Omega + 100k\Omega//R}{50k\Omega}$$

(where 100 kΩ//R is the effective resistance of the 100 kΩ resistor and R connected in parallel.)

For example, if R is 50 kΩ,

$$V_{OUT+'} = 5 \times \frac{50k\Omega + 33.3k\Omega}{50k\Omega} = 8.3V$$

(2) Making $V_{OUT+} > 15V$

Insert a resistor, R, between the SENSE1 pin (pin 17) and the GND pin (pin 42).

$$V_{OUT+'} = V_{CC} \times \frac{50k\Omega//R + 100k\Omega}{50k\Omega//R}$$

Adjusting the negative boosted voltage

(1) Making $V_{OUT-} < -10V$

Insert a resistor, R, between the SENSE2 pin (pin 39) and the GND pin (pin 42).

$$V_{OUT-'} = V_{CC} \times \frac{50k\Omega//R + 50k\Omega}{50k\Omega//R}$$

(2) Making $V_{OUT-} > -10V$

Insert a resistor, R, between the SENSE2 pin (pin 39) and the V_{OUT-} pin (pin 40).

$$V_{OUT-'} = -V_{CC} \times \frac{50k\Omega + 50k\Omega//R}{50k\Omega}$$

For example, if R is 50 kΩ,

$$V_{OUT-'} = -5 \times \frac{50k\Omega + 25k\Omega}{50k\Omega} = -7.5V$$

Note, however, that the above formulas are mere guidelines, that the internal resistances vary between samples, and that therefore each sample will have to be adjusted.

Note also that booster circuit capacity and output load current impose limits on adjustments for boosting V_{OUT+} above 15V and V_{OUT-} below –10V.

(The maximum possible adjustments are 20V for V_{OUT+} and –15V for V_{OUT-}.)

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