

# 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.

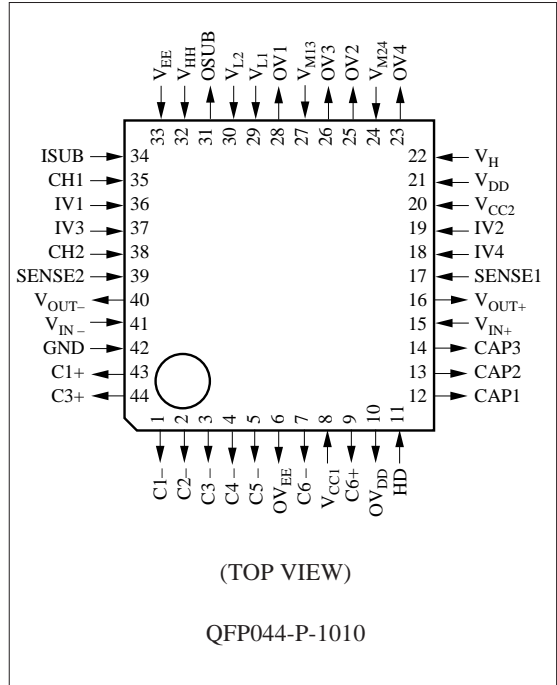
### ■ Features

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

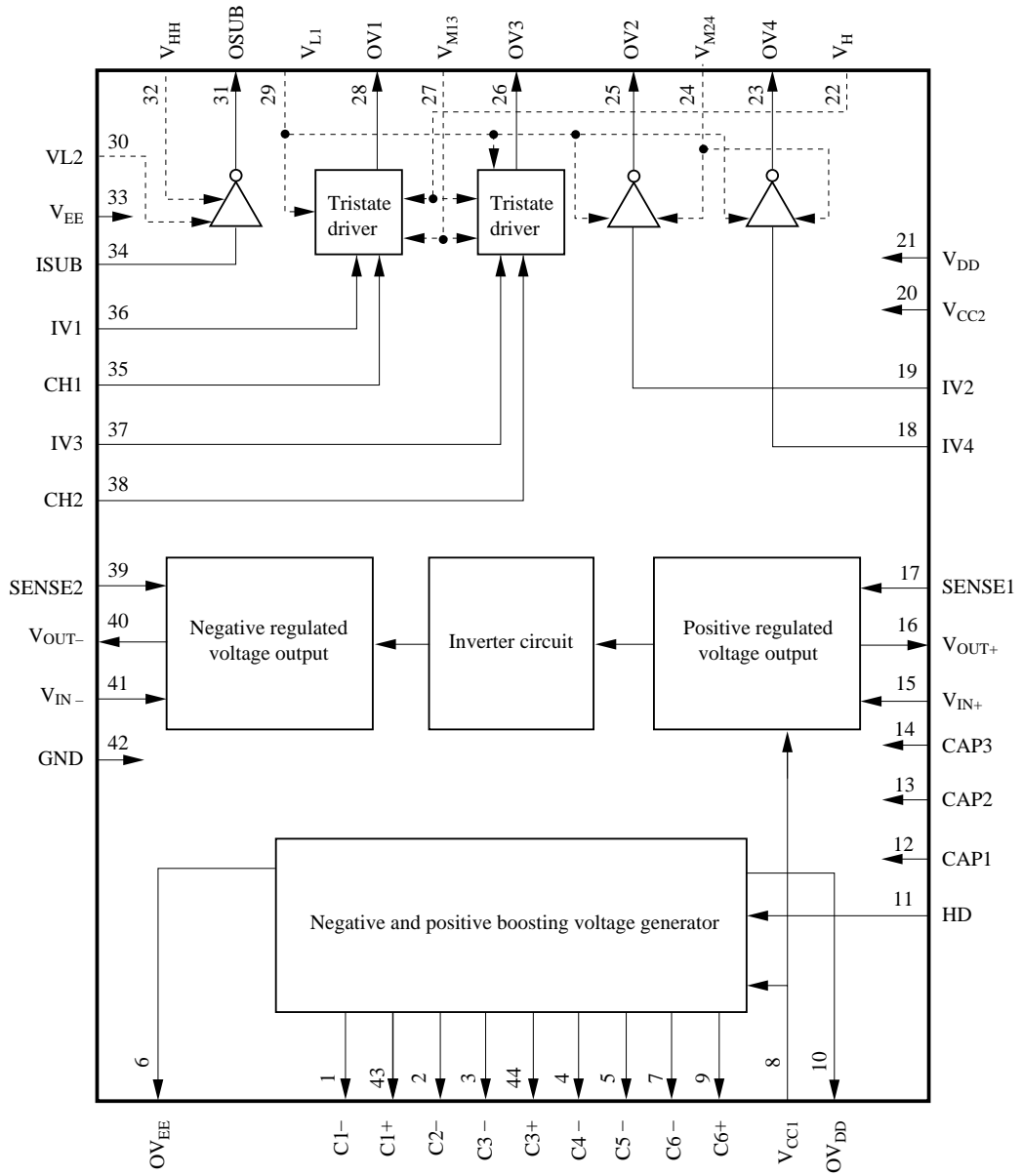
### ■ Applications

- Video cameras

### ■ Pin Assignment



■ Block Diagram



### ■ Pin Descriptions

Pin No.	Symbol	Pin Name	I/O	Function Description
8	$V_{CC1}$	"H" level power supply	I	"H" level input for 5 volt circuits
20	$V_{CC2}$	for input block		
42	GND	"L" level power supply	I	"L" level input for 5 volt circuits
		for input block		
22	$V_H$	"H" level power supply	I	"H" level input for high-voltage circuits
		for vertical driver		
32	$V_{HH}$	"H" level power supply	I	"H" level input for high-voltage circuits
		for SUB driver		
27	$V_{M13}$	"M" level power supply	I	"M" level input for high-voltage circuits
24	$V_{M24}$	for vertical driver		
29	$V_{L1}$	"L" level power supply	I	"L" level input for high-voltage circuits
		for vertical driver		
30	$V_{L2}$	"L" level input	I	"L" level input for high-voltage circuits
		for SUB driver		
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	I	Positive regulated voltage block
		block voltage input		voltage input pin
41	$V_{IN-}$	Negative regulated voltage	I	Negative regulated voltage block
		block voltage input		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	I	Positive voltage control sensing pin
		input		
39	SENSE2	Negative voltage sensing	I	Negative voltage control sensing pin
		input		
43	C1+	C1 connection	O	Booster block voltage charging capacitor
1	C1-			connection pins
2	C2+	C2 connection	O	Booster block voltage charging capacitor
	C2-			connection pins
44	C3+	C3 connection	O	Booster block voltage charging capacitor
3	C3-			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 <sub>DD</sub>	Booster block positive voltage output	O	Booster block positive voltage output pin
6	OV <sub>EE</sub>	Booster block negative voltage output	O	Booster block negative voltage output pin
16	V <sub>OUT+</sub>	Positive regulated voltage output	O	Positive regulated voltage output pin
40	V <sub>OUT-</sub>	Negative regulated voltage output	O	Negative regulated voltage output pin
23	OV4	Binary transfer pulse output	O	Binary (V <sub>M24</sub> , V <sub>L1</sub> ) transfer pulse output pin
25	OV2	Binary transfer pulse output	O	Binary (V <sub>M24</sub> , V <sub>L1</sub> ) transfer pulse output pin
26	OV3	Tristate transfer pulse output	O	Tristate (V <sub>H</sub> , V <sub>M13</sub> , V <sub>L1</sub> ) transfer pulse output pin
28	OV1	Tristate transfer pulse output	O	Tristate (V <sub>H</sub> , V <sub>M13</sub> , V <sub>L1</sub> ) transfer pulse output pin
31	OSUB	SUB pulse output	O	Unwanted charge (V <sub>HH</sub> , V <sub>L2</sub> ) 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	OV2
IV4	OV4
H	L
L	M

### Tristate transfer pulses (vertical driver block)

CH1	IV1	OV1
CH2	IV3	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

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

$V_{CC1}=V_{CC2}=5.0V (=V_{CC})$ ,  $V_{L1}=-7.0V$ ,  $V_{L2}=-10.0V$ ,  $T_a=+25^\circ C$

Parameter	Symbol	Test conditions	min	typ	max	Unit
Quiescent supply current	$I_{DDST}$	$V_I=GND, V_{CC}$		2	4	mA
Operating supply current	$I_{DDYN}$	$V_I=GND, V_{CC}$		45	90	mA
Power supply output pins		$OV_{DD}, OV_{EE}$				
Positive voltage stabilization circuit output voltage	$V_{OUT+}$	$V_I=GND, V_{CC}, I_O=-7mA$ $f_{INH D}=15.7kHz$	14.5	15.0	15.5	V
Negative voltage stabilization circuit output voltage	$V_{OUT-}$	$V_I=GND, V_{CC}, I_O=-2mA$ $f_{INH D}=15.7kHz$	-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			$\pm 1$	$\mu A$
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	$\Omega$
Output on resistance "L" level	$R_{ONL1}$	$I_{OL1}=50mA$			40	$\Omega$
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	$\Omega$
Output on resistance "M" level	$R_{ONM2}$	$I_{OM2}=\pm 50mA$			40	$\Omega$
Output on resistance "L" level	$R_{ONL2}$	$I_{OL2}=50mA$			40	$\Omega$
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	$\Omega$
Output on resistance "L" level	$R_{ONL3}$	$I_{ONL3}=50mA$			40	$\Omega$

## (2) AC characteristics

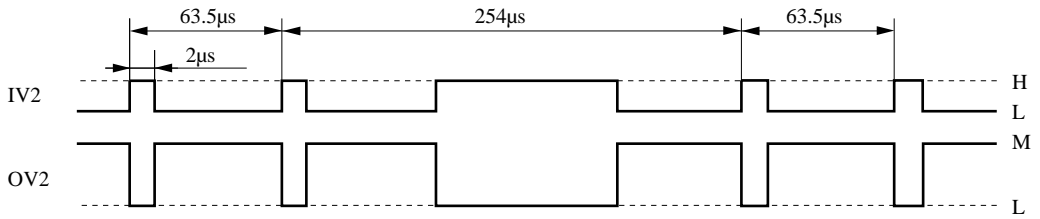
 $V_{HH}=V_H=15.0V$  ,  $V_{M13}=V_{M24}=1.0V$  ,  $GND=0.0V$  ,

 $V_{CC1}=V_{CC2}=5.0V (=V_{CC})$  ,  $V_{L1}=-7.0V$  ,  $V_{L2}=-10.0V$  ,  $T_a=+25^{\circ}C$ 

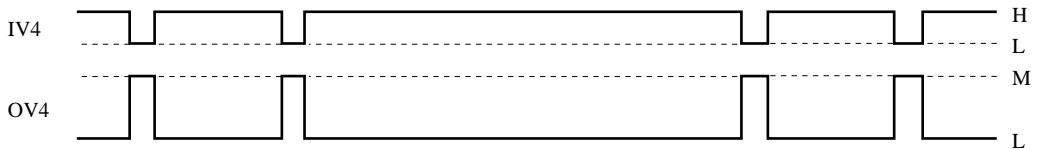
Parameter	Symbol	Test Conditions	min	typ	max	Unit
Output pins 1 (Binary output)		OV2 , OV4				
Transmission delay time	$t_{PLM}$ $t_{PML}$	No load From "L" level to "M" level		100	200	ns
Rise time	$t_{TLM}$			200	300	ns
Fall time	$t_{TML}$					
Output pins 2 (Tristate output)		OV1 , OV3				
Transmission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

■ Timing Chart

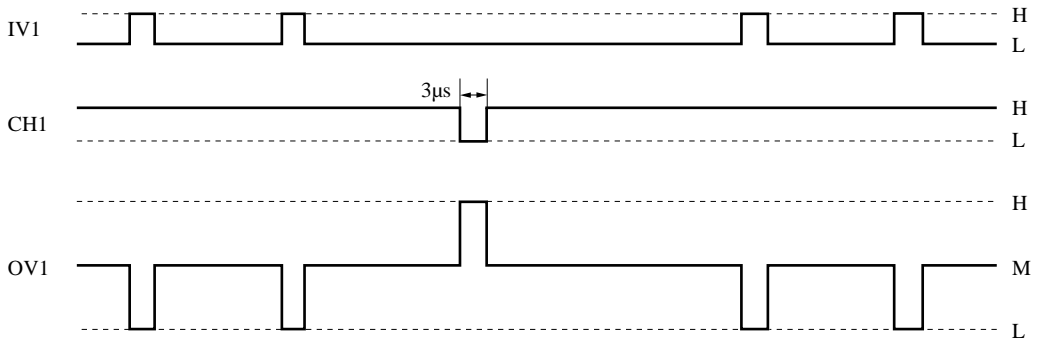
1. Binary transfer pulses



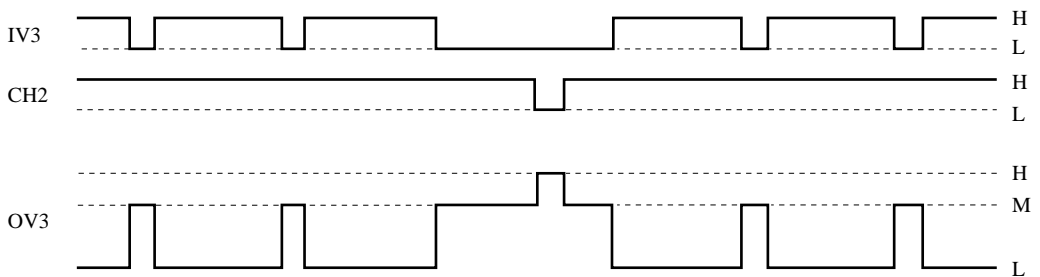
2. Binary transfer pulses



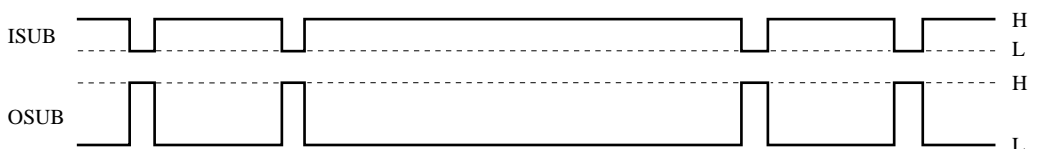
3. Tristate transfer pulses



4. Tristate transfer pulses

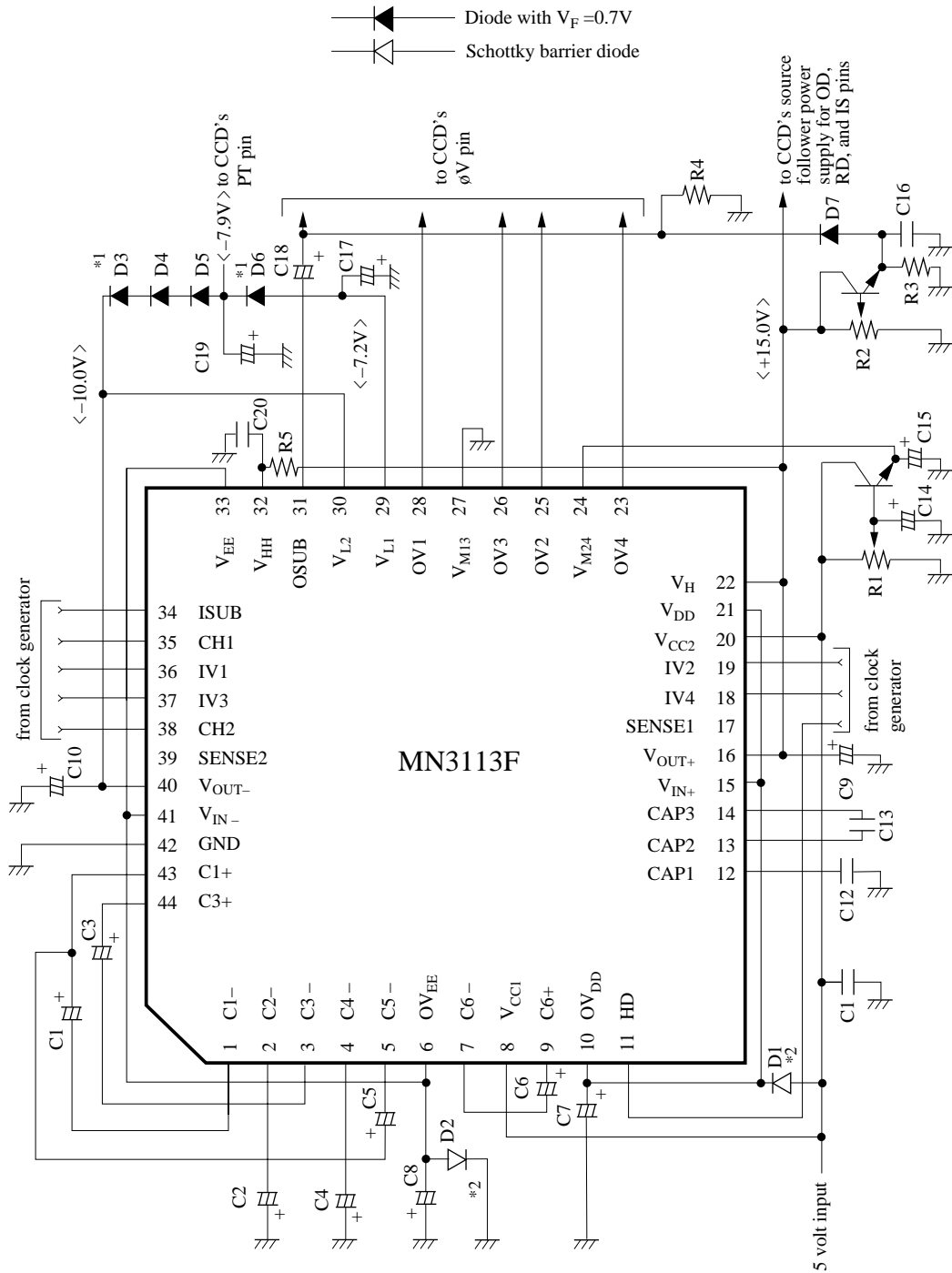


5. SUB pulses





■ Application Circuit Example

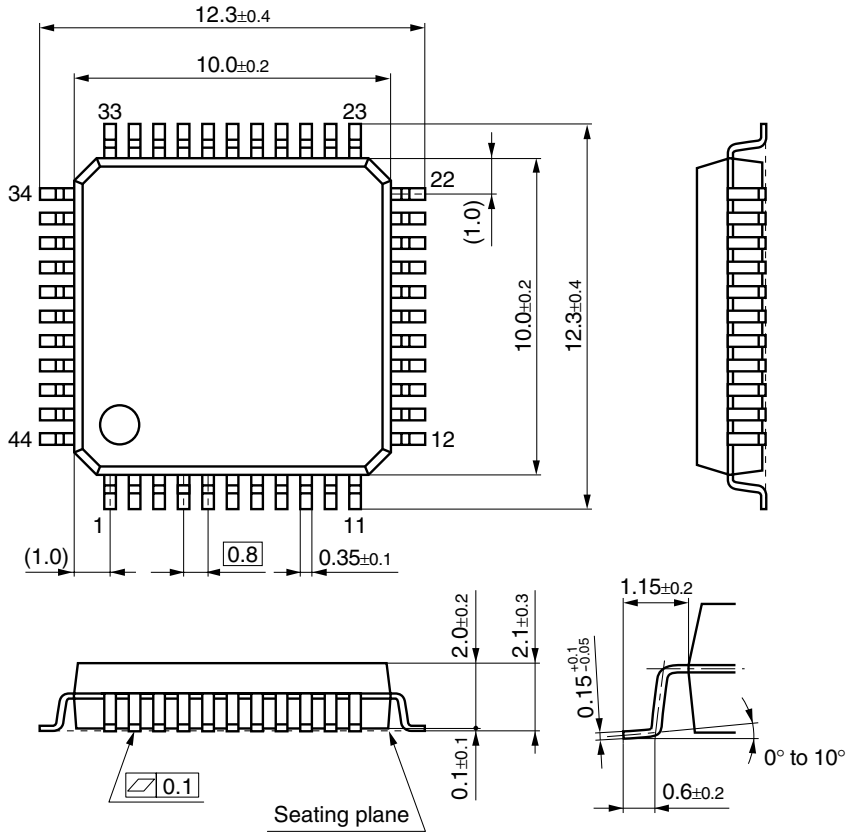


Notes

- \*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)

QFP044-P-1010



Note) The package of this product will be changed to lead-free type (QFP044-P-1010E). See the new package dimensions section later of this datasheet.

■ Usage Notes

External components

1. This product requires two Schottky barrier diodes.

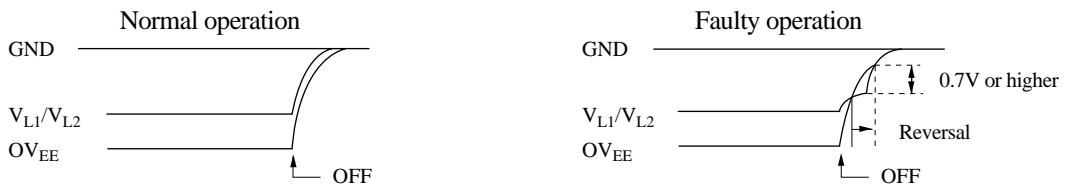
We recommend the following components.

Schottky barrier diodes: MA723 or equivalents

Ta=25°C

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

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  $100\text{ k}\Omega/R$  is the effective resistance of the  $100\text{ k}\Omega$  resistor and R connected in parallel.)

For example, if R is  $50\text{ k}\Omega$ ,

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

##### (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  $50\text{ k}\Omega$ ,

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

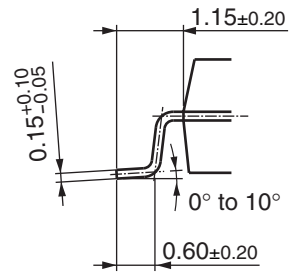
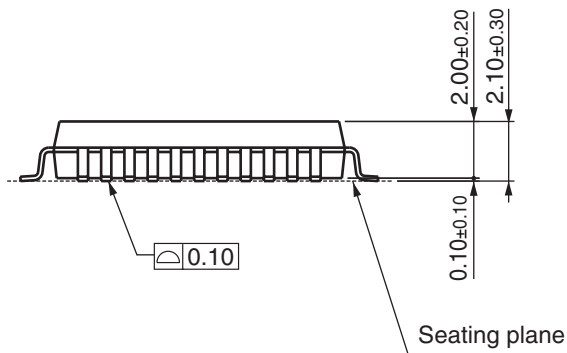
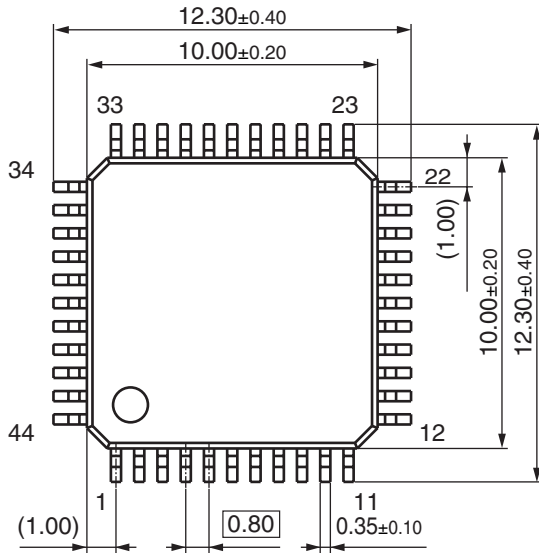
Note, however, that the above formulas are mere guidelines, that the internal resistances vary between samples, and that therefore each sample will have to be adjusted.

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  $V_{OUT-}$ .)

■ New Package Dimensions (Unit: mm)

- QFP044-P-1010E (Lead-free package)



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