NEC

MOS INTEGRATED CIRCUIT
μPD161661

POWER SUPPLY FOR TFT-LCD DRIVER

DESCRIPTION

The μPD161661 is a power supply IC for TFT-LCD driver. This ICs can generate the levels which TFT-LCD driver need, from single voltage input.

FEATURES

• To generate 3 levels from single voltage input
• To integrate regulator circuit for source driver

ORDERING INFORMATION

Part number	Package
μPD161661P/W	Chip/Wafer

Remark Purchasing the above chip entails the exchange of documents such as a separate memorandum or product quality, so please contact one of our sales representative.

The information contained in this document is being issued in advance of the production cycle for the device. The parameters for the device may change before final production or NEC Corporation, at its own discretion, may withdraw the device prior to its production.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

1. BLOCK DIAGRAM/SYSTEM DIAGRAM
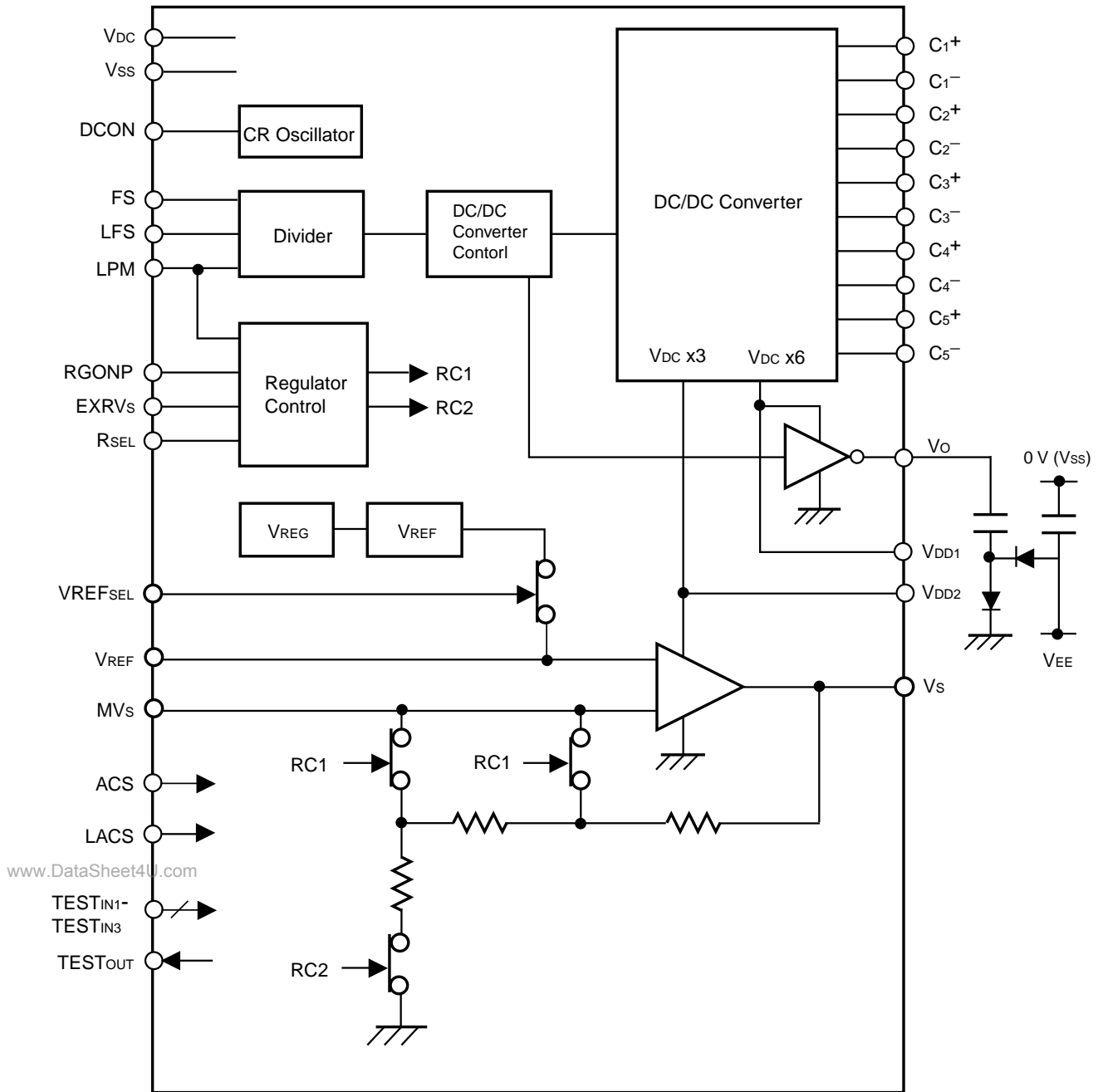
Remark /xxx indicates active low signal.
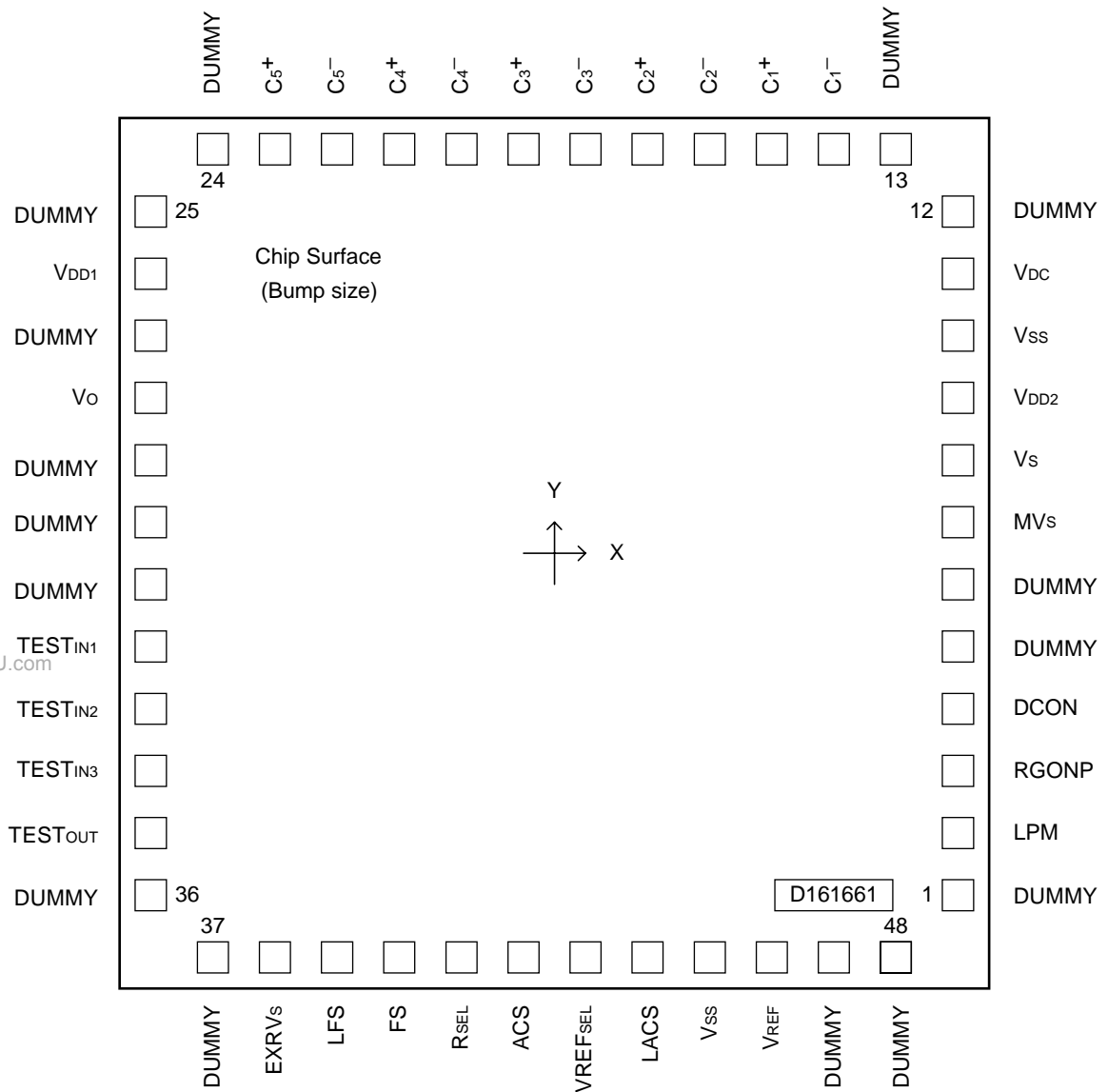
2. PIN CONFIGURATION (Pad Layout)

Chip size: X = 3.60 mm, Y = 3.40 mm

Pad size : 100 x 100 μm^2 TYP.

(1) Alignment mark

T.B.D.

(2) Arrangement

Remark T.B.D. : To be determined.

Table 2-1. Pad Layout

Pad No.	Pad name	X[mm]	Y[mm]
1	DUMMY	1632	−1237.5
2	LPM	1632	−1012.5
3	RGONP	1632	−787.5
4	DCON	1632	−562.5
5	DUMMY	1632	−337.5
6	DUMMY	1632	−112.5
7	MV_S	1632	112.5
8	V_S	1632	337.5
9	V_{DD2}	1632	562.5
10	V_{SS}	1632	787.5
11	V_{DC}	1632	1012.5
12	DUMMY	1632	1237.5
13	DUMMY	1237.5	1532
14	C_1^-	1012.5	1532
15	C_1^+	787.5	1532
16	C_2^-	562.5	1532
17	C_2^+	337.5	1532
18	C_3^-	112.5	1532
19	C_3^+	−112.5	1532
20	C_4^-	−337.5	1532
21	C_4^+	−562.5	1532
22	C_5^-	−787.5	1532
23	C_5^+	−1012.5	1532
24	DUMMY	−1237.5	1532
25	DUMMY	−1632	1237.5
26	V_{DD1}	−1632	1012.5
27	DUMMY	−1632	787.5
28	V_O	−1632	562.5
29	DUMMY	−1632	337.5
30	DUMMY	−1632	112.5
31	DUMMY	−1632	−112.5
32	$TEST_{IN1}$	−1632	−337.5
33	$TEST_{IN2}$	−1632	−562.5
34	$TEST_{IN3}$	−1632	−787.5
35	$TEST_{OUT}$	−1632	−1012.5
36	DUMMY	−1632	−1237.5

Pad No.	Pad name	X[mm]	Y[mm]
37	DUMMY	−1237.5	−1532
38	$EXRV_S$	−1012.5	−1532
39	LFS	−787.5	−1532
40	FS	−562.5	−1532
41	R_{SEL}	−337.5	−1532
42	ACS	−112.5	−1532
43	$VREF_{SEL}$	112.5	−1532
44	LACS	337.5	−1532
45	V_{SS}	562.5	−1532
46	V_{REF}	787.5	−1532
47	DUMMY	1012.5	−1532
48	DUMMY	1237.5	−1532

3. PIN FUNCTIONS

(1/2)

Symbol	Pin Name	Pad No.	I/O	Description
V_{DC}	Power supply	11	–	Power supply for logic circuit and DC/DC converter.
V_{SS}	Ground	10, 45	–	Ground for logic circuit and DC/DC converter power supply.
V_{DD1}	DC/DC converter output	26	–	x6 voltage boost output of DC/DC converter. Outputs a potential that is V_{DC} boosted to six times the original level. Use this pin connected to a voltage stabilization capacitor.
V_{DD2}	DC/DC converter output	9	–	x3 voltage boost output of DC/DC converter. Outputs a potential that is V_{DC} boosted to three times the original level. Use this pin connected to a voltage stabilization capacitor.
V_O	Rectangle signal output for negative boost	28	–	Rectangle signal output for negative boost. A potential that is V_{DC} boosted to five times the original level is used for the V_O voltage range. A negative power supply can be created for gate IC bottom output by connecting an external component to this pin.
V_S	Regulator output	8	–	Regulator output for source driver. Use this pin connected to a voltage stabilization capacitor.
V_{REF}	Reference voltage input/output	46	I/O	Reference voltage input/output of V_S regulator. The internal reference supply voltage is used when $VREF_{SEL}$ = L. At this time, this pin can also be used as the reference voltage output of the negative power supply regulator incorporated in the gate driver, etc. When $VREF_{SEL}$ = H, the external reference voltage can be input as the regulator reference voltage.
DCON	DC/DC converter control	4	I	DC/DC converter ON/OFF control. Use this pin connected to DC/DC converter control pin (DCON) of source driver or the control port output of CPU. DCON = H : DC/DC converter ON. DCON = L : DC/DC converter OFF
RGONP	Regulator control	3	I	Regulator ON/OFF control for source driver voltage (V_S). Use this pin connected to the regulator control pin (RGONP) of the source driver or the control port output of CPU. RGONP = H : Regulator ON. RGONP = L : Regulator OFF
$EXRV_S$	V_S regulating resistor selection	38	I	This pin selects whether to use the internal feedback resistor or connect an external resistor for the V_S regulator amplifier. When external resistor connection is selected, configure a feedback circuit between the MV_S, V_S, and V_{SS} pins by connecting an external resistor. $EXRV_S$ = H: External resistor connection. $EXRV_S$ = L: Internal feedback resistor used.

(2/2)

Symbol	Pin Name	Pad No.	I/O	Description
MV$_S$	V$_S$ regulator input	7	–	Feedback input (+) of the regulator amplifier for V$_S$ output. This pin is used as follows according to the setting of EXRV$_S$. EXRV$_S$ = H : To connect external resistor. EXRV$_S$ = L : Leave it open.
R$_{SEL}$	Internal resistor selection for regulator	41	I	This pin selects the internal resistor for the regulator and sets the source driver supply voltage output from the V$_S$ pin as follows. Note that this pin setting is valid when EXRV$_S$ = L. R$_{SEL}$ = H: 5.0 V V$_S$ output voltage R$_{SEL}$ = L: 4.0 V V$_S$ output voltage
VREF$_{SEL}$	Regulator reference voltage input selection	43	I	This pin selects external or internal reference voltage of V$_S$ regulator. When external reference is selected, input reference voltage from V$_{REF}$ pin. VREF$_{SEL}$ = H : External reference voltage is selected. VREF$_{SEL}$ = L : Internal reference voltage is selected.
LPM	Low power mode signal	2	I	Control signal for low power mode. LPM = H : Low power mode LPM = L : Normal mode The settings made by the LACS and LFS pins are valid in the low power mode, and settings made by the ACS and FS pins are valid in the normal mode. Connect to low power mode setting pin (LPMP) of source driver or control port output of CPU.
ACS	Amp current selection	42	I	To select Amp current in normal mode. For detail, refer to **4. MODE DESCRIPTION.**
LACS	Amp current selection	44	I	To select Amp current in low power mode. For detail, refer to **4. MODE DESCRIPTION.**
FS	OSC frequency selection	40	I	To select OSC frequency for DC/DC converter when in normal mode. For detail, refer to **4. MODE DESCRIPTION.**
LFS	Low power mode OSC frequency selection	39	I	To select OSC frequency for DC/DC converter in low power mode. For detail, refer to **4. MODE DESCRIPTION.**
C$_1$$^+$, C$_1$$^-$ C$_2$$^+$, C$_2$$^-$ C$_3$$^+$, C$_3$$^-$ C$_4$$^+$, C$_4$$^-$ C$_5$$^+$, C$_5$$^-$	Capacitor connect pin for boost	15, 14 17, 16 19, 18 21, 20 23, 22	–	Capacitor connect pin for boost of DC/DC converter. Connect these pins between each C$_n$$^+$ and C$_n$$^-$. The capacitance and tolerance of each capacitor are shown below. Capacitance : 1 μF Tolerance : 10 V
TEST$_{IN1}$ to TEST$_{IN3}$	Test	32 to 34	I	IC test mode pin. Normally, leave it open.
TEST$_{OUT}$	TEST output	35	O	IC test mode pin. Normally, leave it open.
DUMMY	Dummy pin	1, 5, 6, 12, 13, 24, 25, 27, 29 to 31, 36, 37, 47, 48	–	Dummy pin. Leave it open.

4. MODE DESCRIPTION

DC/DC converter control

DCON	H	DC/DC converter ON
	L	DC/DC converter OFF

Regulator control

RGONP	H	Regulator ON
	L	Regulator OFF (Vs output : High impedance)

Vs regulating resistor

EXRVs	H	External resistor
	L	Internal resistor

Regulator reference voltage input selection

VREFSEL	H	V_{REF} : External reference voltage input
	L	V_{REF} : Internal reference voltage output

Vs regulator selection

		Vs
R_{SEL}	H	5.0 V
	L	4.0 V

Amp current selection

ACS, LACS [Note]	Vs		
	Source current	Sink current	Amp current
H	3 mA >	0.5 μA	1 μA
L	3 mA >	5 μA	10 μA

Note   ACS   : Selection of current during normal driving

LACS   : Selection of current in low power mode

OSC frequency selection

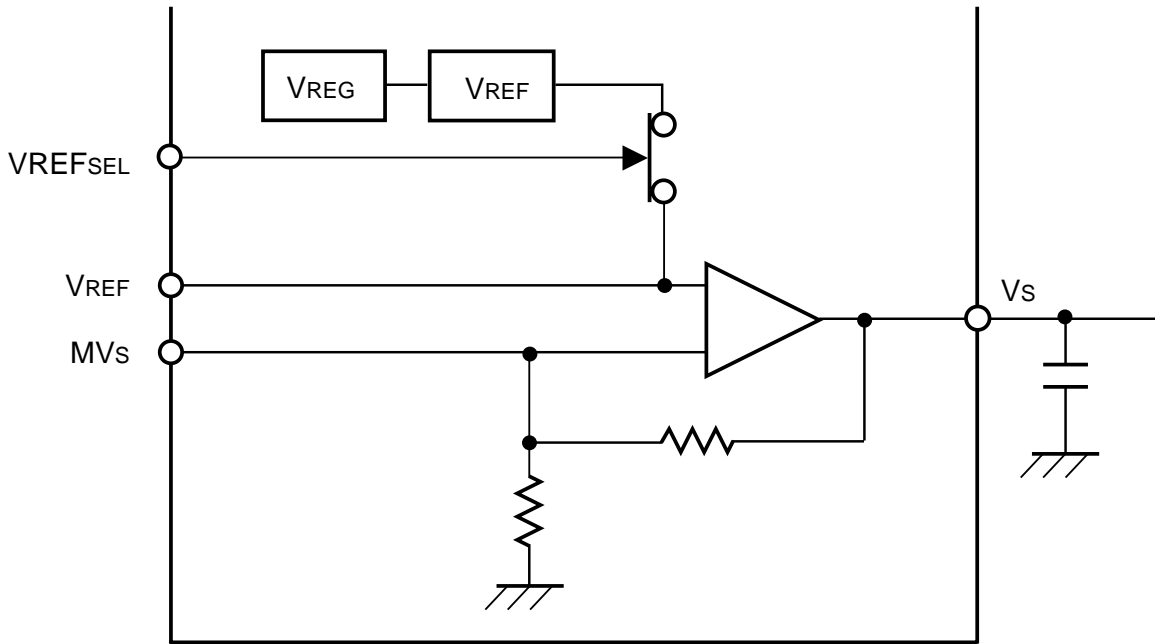| FS, LFS [Note]	OSC
H	$f_{OSC}/8$
L	$f_{OSC}/2$

Note   FS   : Selection of current during normal driving

LFS   : Selection of current in low power mode

Low power mode selection

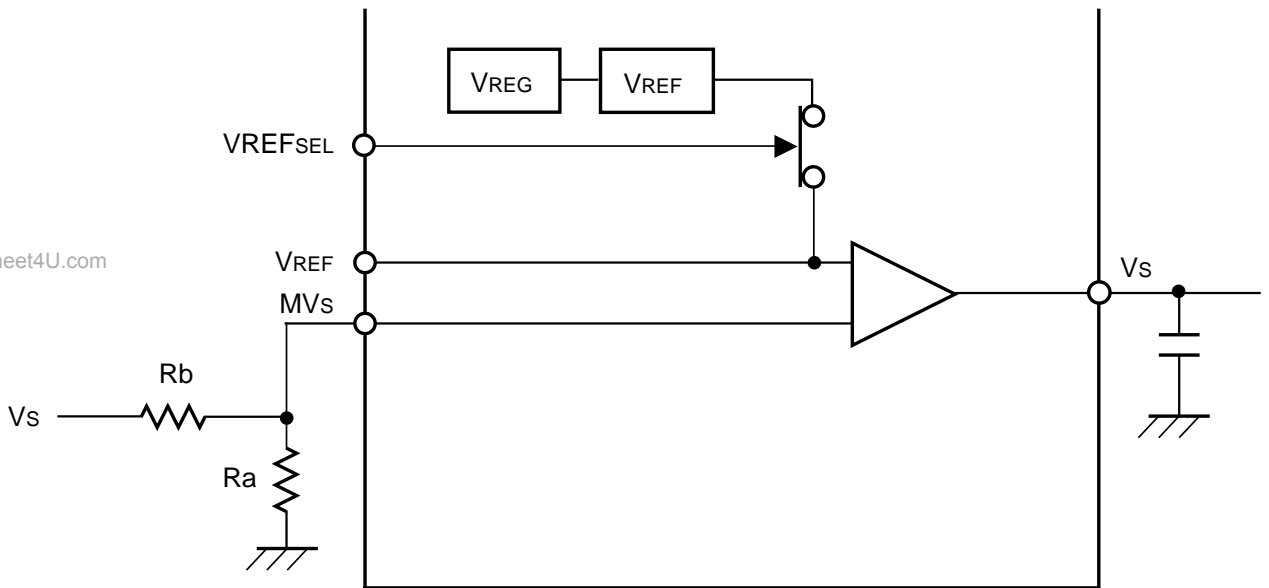| LPM	Drive mode
H	Low power mode The settings made by LACS and LFS are valid.
L	Normal mode The settings made by AC and FS are valid.

Figure 4-1. Example of Internal/External resistor for the regulator

<Internal resistor [EXRVs = L]>

<External resistor [EXRVs = L]>

Remark $V_S = (1+Rb/Ra) V_{REF}$

5. POWER ON/OFF SEQUENCE

5.1 Power ON Sequence

T.B.D.

5.2 Power OFF Sequence

T.B.D.

6. ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings (T$_A$ = 25°C, V$_{SS}$ = 0 V)

Parameter	Symbol	Rating	Unit
Supply Voltage	V$_{DC}$	−0.5 to + 6.0	V
Input Voltage	V$_I$	−0.5 to V$_{DC}$ + 0.5	V
Input Current	I$_I$	±10	mA
Output Voltage	V$_{DD1}$	−0.5 to +38	V
Output Current	I$_O$	±10	mA
Operating Ambient Temperature	T$_A$	−30 to +85	°C
Storage Temperature	T$_{stg}$	−55 to +125	°C

Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

Recommended Operating Conditions (T$_A$ = −30 to +85°C, V$_{SS}$ = 0 V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply Voltage	V$_{DC}$		2.50	2.85	3.60	V
Input Voltage	V$_I$		0		V$_{DC}$	V

Electrical Characteristics (Unless otherwise specified, T$_A$ = −30 to +85°C, V$_{DC}$ = 2.5 to 3.6 V, V$_{SS}$ = 0 V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
High Level Input Voltage	V$_{IH}$		0.7 V$_{DC}$			V
Low Level Output Voltage	V$_{IL}$				0.3 V$_{DC}$	V
Boost Voltage	V$_{DD1}$	ACS (LACS) = H, FS (LFS) = L, I$_{DD1}$ = 100 μA	5 V$_{DC}$		6 V$_{DC}$	V
Boost Voltage	V$_{DD1}$	ACS (LACS) = H, FS (LFS) = H, I$_{DD1}$ = 100 μA	5 V$_{DC}$		6 V$_{DC}$	V
Output Voltage	V$_{S1}$	Rsel = H, FS (LFS) = L, I$_S$ = 3.0 mA	4.5	5	5.5	V
Output Voltage	V$_{S2}$	Rsel = L, FS (LFS) = L, I$_S$ = 3.0 mA	3.5	4	4.5	V
V$_{DC}$ Static Current Consumption	V$_{DC1}$	ACS (LACS) = H, FS (LFS) = L, I$_{DD1}$ = I$_S$ = 0.0 mA			T.B.D.	μA
V$_{DC}$ Static Current Consumption	I$_{vdcd}$	ACS (LACS) = H, FS (LFS) = L, I$_{DD1}$ = I$_S$ = 0.0 mA			T.B.D.	μA
V$_{REF}$ Voltage			2.25	2.50	2.75	V

[MEMO]

[MEMO]

NOTES FOR CMOS DEVICES

① **PRECAUTION AGAINST ESD FOR SEMICONDUCTORS**

Note:

Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② **HANDLING OF UNUSED INPUT PINS FOR CMOS**

Note:

No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V$_{DD}$ or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ **STATUS BEFORE INITIALIZATION OF MOS DEVICES**

Note:

Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.