IXD2110/IXD2111

Step-Up DC/DC Converter / Controller

FEATURES

- **Operating Input Voltage Range**: 0.9V ~ 10.0V
- **Output Voltage Range**: 1.5V~7.0V with (0.1V increments, accuracy ±2.5%)
- **Maximum Oscillation Frequency**: 100 kHz (180kHz for the IXD2111)
- **Built-in Switching NMOSFET (**A/C/E type) or **External Transistor (**B/D/F type)
- **Low Operating Supply Current**: 2.0μA
- **Small Package**: SOT-23 & SOT89 (for IXD2111 series),SOT-25, USP-6C 8-pin 2 x 3 x 0.8 mm TDFN package

APPLICATION

- **Mobile phones**
- **Cameras, VCRs**
- **Various portable equipment**

DESCRIPTION

The IXD2110/IXD2111 series is a group of PFM step-up DC/DC converter/controller ICs, designed to generate low supply voltage. The series is ideal for applications where a longer battery life is needed such as in portable communication equipment. With a built-in 2.5 Ω N-channel driver transistor, the IXD2110A/C/E and IXD2111A/C/E types provide a step-up operation by using only an inductor, a capacitor, and a diode connected externally.

The IXD2110/111B, D, and F versions can be used with an external transistor for applications requiring larger currents.

Output voltage is internally programmed in a range from 1.5V to 7.0V in increments of 0.1V (accuracy ± 2.5%).

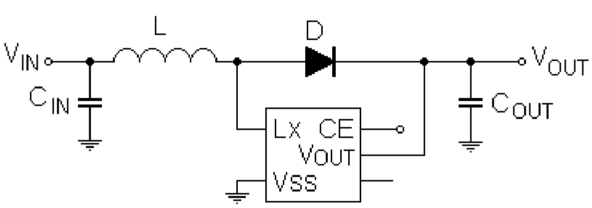
Maximum oscillation frequency is set to 100 kHz for IXD2110/111 series. (At light loads, it is set to 180 kHz for the IXD2111 series.)

Options include products equipped with a CE pin (C and D versions) that allows the IC to be shut down, thereby reducing supply current, and with separated V_{DD}/V_{OUT} pins (E and F versions) to separate the power supply block and the output voltage detect block.

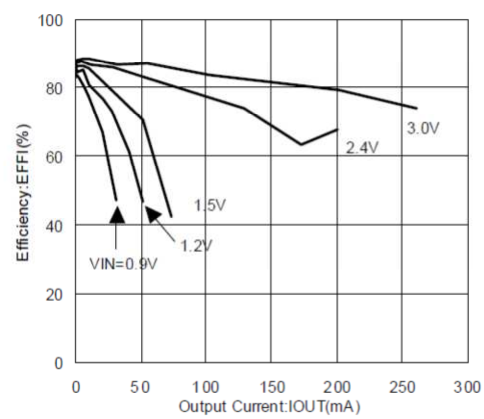
With the IXD2110 series, maximum duty cycle is set to 75% (V_{DD} = 3.3 V) making it suitable for use with large current operations. The IXD2111 series automatically switches duty ratio between 56% & 75% (V_{DD} = 3.3 V) to drop output ripple voltage, when it senses changes in load, It can support both large and small currents.

The external transistor types (B/D/F types) designed for applications, which require larger currents.

TYPICAL APPLICATION CIRCUIT



TYPICAL PERFORMANCE CHARACTERISTIC



ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNITS
V_{OUT} Voltage		V_{OUT}	– 0.3 ~ 12.0	V
Lx Pin Voltage		V_{Lx}	– 0.3 ~ 12.0	V
Lx Pin Current		I_{Lx}	400	mA
EXT Pin Voltage		V_{EXT}	V_{SS} – 0.3 ~ V_{OUT} + 0.3	V
EXT Pin Current		I_{EXT}	100	mA
CE Input Voltage		V_{CE}	– 0.3 ~ 12.0	V
VDD Input Voltage		V_{DD}	– 0.3 ~ 12.0	V
Power Dissipation	SOT-23, 25	P_D	250	mW
	SOT-89		500	
	USP-6C		100	
Operating Temperature Range		T_{OPR}	– 40 ~ + 85	^{0}C
Storage Temperature Range		T_{STG}	– 55 ~ +125	^{0}C

ELECTRICAL OPERATING CHARACTERISTICS

IXD2111Axx1MR

Ta = 25 ^{0}C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	Connected to external components	x 0.975	V_{OUT}	x 1.025	V	①
Output Voltage Temperature Characteristics	$\frac{\Delta Vout}{Vout * \Delta Topr}$	Connected to external components - 40 ^{0}C ≤ Topr ≤ 85 ^{0}C		± 100		ppm/^{0}C	①
Maximum Input Voltage	V_{IN}		10	-	-	V	①
Operating Start Voltage	V_{ST1}	I_{OUT} = 1 mA, Connected to external components	-	0.8	0.9	V	①
Oscillation Start Voltage	V_{ST2}	Applied 0.8 V to V_{OUT}, Vpull = 1.0 V	-	-	0.8	V	②
Operating Hold Voltage	V_{HLD}	I_{OUT} = 1 mA, Connected to external components	0.7	-	-	V	①
Input Current at No Load	I_{IN}	I_{OUT} = 0 mA (*1)	-	E1-1(*)	E1-2(*)	µA	①
Supply Current 1 (*2)	I_{DD1}	Applied (output voltage x0.95) to V_{OUT}	-	E2-1(*)	E2-2(*)	µA	②
Supply Current 2	I_{DD2}	Applied (output voltage + 0.5) to V_{OUT}	-	E3-1(*)	E3-2(*)	µA	②
Lx Switch ON Resistance	R_{SWON}	Same as I_{DD1}, V_{Lx} = 0.4 V (*3)	-	E4-1(*)	E4-2(*)	Ω	②
Lx Leak Current	I_{LxL}	Same as I_{DD2}, V_{Lx} = 7 V	-	-	1	µA	②
Duty Ratio	DTY	Same as I_{DD1}, measure Lx waveform	E7-1(*)	E7-2(*)	E7-3(*)	%	②
Duty Ratio 2	DTY2	I_{OUT} = 1 mA, measure Lx ON time. Connect to external components	48	56	64	%	①
Maximum Oscillation Frequency	$MAXf_{OSC}$	Same as I_{DD1}	85	100	115	kHz	②
Maximum Oscillation Frequency 2	$MAXf_{OSC2}$	Same as I_{DD1}	153	180	207	kHz	②
Lx Limit Voltage (*4)	V_{LxLMT}	Same as I_{DD1}, V_{Lx} when max oscillation frequency is more than double	0.7	-	1.1	V	②
Efficiency (*5)	EFFI	Connect to external components	-	E8(*)	-	%	①

Test condition: Unless otherwise specified, V_{IN} = V_{OUT} × 0.6, I_{OUT} ≤ C1 (*), Vpull = 5.0 V

NOTE:
*1: XBS104S14R-G is used, reverse current I_R < 1µA (when reverse voltage V_R = 10 V is applied), in case of using selected parts.
*2: Supply Current 1 is the value when the IC is constantly switching. In actual operation, the oscillator periodically switches, resulting in lower power consumption. Please refer to Input Current (I_{IN}) under no load condition for the actual current, which is supplied from the input power supply (V_{IN}).
*3: Lx switch ON resistance can be calculated by (V_{Lx} x Rp) / (Vpull - V_{Lx}). * Change Vpull so that V_{Lx} will become 0.4 V.
*4: The Lx limit voltage function becomes stable when V_{OUT} is over 2.0 V.
*5: EFFI = {[output voltage] × (output current)} / [(input voltage) × (input current)] ×100
*6: Please be aware of the absolute maximum ratings of the external components.
(*): Please refer to the charts.

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

IXD2111Bxx1MR

Ta = 25 ^{0}C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	Connected to external components	x 0.975	V_{OUT}	x1.025	V	⑥
Output Voltage Temperature Characteristics	$\frac{\Delta Vout}{Vout * \Delta Topr}$	Connected to external components - 40 ^{0}C ≤ Topr ≤ 85 ^{0}C		± 100		ppm/^{0}C	⑥
Maximum Input Voltage	V_{IN}		10	-	-	V	
Operating Start Voltage	V_{ST1}	I_{OUT} = 1 mA, Connected to external components	-	0.8	0.9	V	⑥
Oscillation Start Voltage	V_{ST2}	Applied 0.8 V to V_{OUT}	-	-	0.8	V	⑦
Operating Hold Voltage	V_{HLD}	I_{OUT} = 1 mA, Connected to external components	0.7	-	-	V	⑥
Supply Current 1 (*1)	I_{DD1}	Applied (output voltage x0.95) to V_{OUT}	-	E2-1(*)	E2-2(*)	µA	⑦
Supply Current 2	I_{DD2}	Applied (output voltage + 0.5) to V_{OUT}	-	E3-1(*)	E3-2(*)	µA	⑦
EXT "H" ON Resistance	R_{EXTH}	Same as I_{DD1}, V_{EXT} = VOUT - 0.4 V (*2)	-	E5-1(*)	E5-2(*)	Ω	②
EXT "L" ON Resistance	R_{EXTL}	Same as I_{DD1}, V_{EXT} = 0.4 V (*3)	-	E6-1(*)	E6-2(*)	Ω	②
Duty Ratio	DTY	Same as I_{DD1}, measure Lx waveform	E7-1(*)	E7-2(*)	E7-3(*)	%	⑦
Duty Ratio 2	DTY2	I_{OUT} = 1 mA, measure Lx ON time. Connect to external components	48	56	64	%	⑥
Maximum Oscillation Frequency	$MAXf_{OSC}$	Same as I_{DD1}	85	100	115	kHz	⑦
Maximum Oscillation Frequency 2	$MAXf_{OSC2}$	Same as I_{DD1}	153	180	207	kHz	⑦
Lx Limit Voltage (*4)	V_{LxLMT}	Same as I_{DD1}, V_{Lx} when max oscillation frequency is more than double	0.7	-	1.1	V	⑦
Efficiency (*5)	EFFI	Connect to external components	-	E9(*)	-	%	⑥

Test condition: Unless otherwise specified, V_{IN} = V_{OUT} × 0.6, I_{OUT} ≤ C1 (*)

NOTE:
*1: Supply Current 1 is the value when the IC is constantly switching. In actual operation, the oscillator periodically switches, resulting in lower power consumption.
*2: EXT 'H' ON resistance can be calculated by (0.4 x Rp) / (VEXT – Vpull). * Change Vpull so that V_{EXT} will become V_{OUT} - 0.4 V.
*3: EXT 'L' ON resistance can be calculated by (V_{EXT} x Rp) / (Vpull - V_{EXT}). * Change Vpull so that V_{EXT} will become 0.4 V.
*4: EFFI = {[output voltage] × (output current)} / [(input voltage) × (input current)] ×100
*5: Please be aware of the absolute maximum ratings of the external components.
(*): Please refer to the charts.

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

IXD2110Cxx1MR, IXD2111Cxx1MR

Ta = 25 ^{0}C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	Connected to external components	x 0.975	V_{OUT}	x 1.025	V	①
Output Voltage Temperature Characteristics	$\frac{\Delta Vout}{Vout * \Delta Topr}$	Connected to external components - 40 ^{0}C ≤ Topr ≤ 85 ^{0}C		± 100		ppm/^{0}C	①
Maximum Input Voltage	V_{IN}		10	-	-	V	①
Operating Start Voltage	V_{ST1}	I_{OUT} = 1 mA, Connected to external components	-	0.8	0.9	V	①
Oscillation Start Voltage	V_{ST2}	Applied 0.8 V to V_{OUT}, Vpull = 1.0 V	-	-	0.8	V	②
Operating Hold Voltage	V_{HLD}	I_{OUT} = 1 mA, Connected to external components	0.7	-	-	V	①
Input Current at No Load	I_{IN}	I_{OUT} = 0 mA (*1)	-	E1-1(*)	E1-2(*)	µA	①
Supply Current 1 (*2)	I_{DD1}	Applied (output voltage x0.95) to V_{OUT}	-	E2-1(*)	E2-2(*)	µA	②
Supply Current 2	I_{DD2}	Applied (output voltage + 0.5) to V_{OUT}	-	E3-1(*)	E3-2(*)	µA	②
Lx Switch ON Resistance	R_{SWON}	Same as I_{DD1}, V_{Lx} = 0.4 V (*3)	-	E4-1(*)	E4-2(*)	Ω	②
Lx Leak Current	I_{LxL}	Same as I_{DD2}, V_{Lx} = 7 V	-	-	1	µA	②
Duty Ratio	DTY	Same as I_{DD1}, measure Lx waveform	E7-1(*)	E7-2(*)	E7-3(*)	%	②
Duty Ratio 2	DTY2	I_{OUT} = 1 mA, measure Lx ON time. Connect to external components	48	56	64	%	①
Maximum Oscillation Frequency	$MAXf_{OSC}$	Same as I_{DD1}	85	100	115	kHz	②
Maximum Oscillation Frequency 2	$MAXf_{OSC2}$	Same as I_{DD1}	153	180	207	kHz	②
Lx Limit Voltage (*4)	V_{LxLMT}	Same as I_{DD1}, V_{Lx} when max oscillation frequency is more than double	0.7	-	1.1	V	②
Efficiency (*5)	EFFI	Connect to external components	-	E8(*)	-	%	①
Standby Current	I_{STB}	Same as I_{DD1}, V_{CE} = 0 V			0.50	µA	④
CE “High” Voltage	V_{CEH}	Same as I_{DD1}, determine Lx oscillation	0.75			V	④
CE “Low” Voltage	V_{CEL}	Same as I_{DD1}, determine Lx shutdown			0.20	V	④
CE “High” Current	I_{CEH}	Same as I_{DD1}, V_{CE} = V_{OUT} x 0.95			0.25	µA	⑤
CE “Low” Current	I_{CEL}	Same as I_{DD1}, V_{CE} = 0 V			-0.25	µA	⑤

Test condition: Unless otherwise specified, connect CE to V_{OUT}, V_{IN}=V_{OUT} × 0.6, I_{OUT} ≤ C1 (*), Vpull = 5.0 V

NOTE:
*1: XBS104S14R-G is used, reverse current I_R < 1 µA (when reverse voltage V_R = 10 V is applied), in case of using selected parts.
*2: Supply Current 1 is the value when the IC is constantly switching. In actual operation, the oscillator periodically switches, resulting in lower power consumption. Please refer to Input Current (I_{IN}) under no load condition for the actual current, which is supplied from the input power supply (V_{IN}).
*3: Lx switch ON resistance can be calculated by (V_{Lx} x Rp) / (Vpull - VLx). * Change Vpull so that V_{Lx} will become 0.4 V.
*4: The Lx. limit voltage function becomes stable when V_{OUT} of the IXD2110/111 series is over 2.0 V.
*5: EFFI = {[output voltage] × (output current)} / [(input voltage) × (input current)] ×100
*6: Please be aware of the absolute maximum ratings of the external components.
(*): Please refer to the charts.

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

IXD2110Dxx1MR, IXD2111Dxx1MR

Ta = 25 ^{0}C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	Connected to external components	x 0.975	V_{OUT}	x 1.025	V	⑥
Output Voltage Temperature Characteristics	$\frac{\Delta Vout}{Vout * \Delta Topr}$	Connected to external components - 40 ^{0}C ≤ Topr ≤ 85 ^{0}C		± 100		ppm/^{0}C	⑥
Maximum Input Voltage	V_{IN}		10	-	-	V	
Operating Start Voltage	V_{ST1}	I_{OUT} = 1 mA, Connected to external components	-	0.8	0.9	V	⑥
Oscillation Start Voltage	V_{ST2}	Applied 0.8 V to V_{OUT}	-	-	0.8	V	⑦
Operating Hold Voltage	V_{HLD}	I_{OUT} = 1 mA, Connected to external components	0.7	-	-	V	⑥
Supply Current 1 (*1)	I_{DD1}	Applied (output voltage x0.95) to V_{OUT}	-	E2-1(*)	E2-2(*)	µA	⑦
Supply Current 2	I_{DD2}	Applied (output voltage + 0.5) to V_{OUT}	-	E3-1(*)	E3-2(*)	µA	⑦
EXT "H" ON Resistance	R_{EXTH}	Same as I_{DD1}, V_{EXT} = VOUT - 0.4 V (*2)	-	E5-1(*)	E5-2(*)	Ω	②
EXT "L" ON Resistance	R_{EXTL}	Same as I_{DD1}, V_{EXT} = 0.4 V (*3)	-	E6-1(*)	E6-2(*)	Ω	②
Duty Ratio	DTY	Same as I_{DD1}, measure Lx waveform	E7-1(*)	E7-2(*)	E7-3(*)	%	⑦
Duty Ratio 2	DTY2	I_{OUT} = 1 mA, measure Lx ON time. Connect to external components	48	56	64	%	⑥
Maximum Oscillation Frequency	$MAXf_{OSC}$	Same as I_{DD1}	85	100	115	kHz	⑦
Maximum Oscillation Frequency 2	$MAXf_{OSC2}$	Same as I_{DD1}	153	180	207	kHz	⑦
Efficiency (*5)	EFFI	Connect to external components	-	E9(*)	-	%	⑥
Standby Current	I_{STB}	Same as I_{DD1}, V_{CE} = 0 V			0.50	µA	⑤
CE "High" Voltage	V_{CEH}	Same as I_{DD1}, determine Lx oscillation	0.75			V	⑧
CE "Low" Voltage	V_{CEL}	Same as I_{DD1}, determine Lx shutdown			0.20	V	⑧
CE "High" Current	I_{CEH}	Same as I_{DD1}, V_{CE} = V_{OUT} x 0.95			0.25	µA	⑤
CE "Low" Current	I_{CEL}	Same as I_{DD1}, V_{CE} = 0 V			-0.25	µA	⑤

Test condition: Unless otherwise specified, connect CE to V_{OUT}, V_{IN}=V_{OUT} × 0.6, I_{OUT} ≤ C1 (*)

NOTE:
*1: "Supply Current 1" is the value when the IC is constantly switching. In actual operation, the oscillator periodically switches, resulting in lower power consumption.
*2: EXT "H" ON resistance can be calculated by (0.4 x Rp) / (V_{EXT} - Vpull). * Change Vpull so that V_{EXT} will become V_{OUT} - 0.4 V.
*3: EXT "L" ON resistance can be calculated by (V_{EXT} x Rp) / (Vpull - V_{EXT}). * Change Vpull so that V_{EXT} will become 0.4 V.
*4: EFFI = {[output voltage] × (output current)} / [(input voltage) × (input current)] ×100
*5: Please be aware of the absolute maximum ratings of the external components.
(*): Please refer to the charts.

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

IXD2110Exx1MR, IXD2111Exx1MR Ta = 25 ^{0}C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	Connected to external components	x 0.975	V_{OUT}	x 1.025	V	①
Output Voltage Temperature Characteristics	$\frac{\Delta Vout}{Vout * \Delta Topr}$	Connected to external components - 40 ^{0}C ≤ Topr ≤ 85 ^{0}C		± 100		ppm/^{0}C	①
Maximum Input Voltage	V_{IN}		10	-	-	V	①
Operating Start Voltage	V_{ST1}	I_{OUT} = 1 mA, Connected to external components	-	0.8	0.9	V	①
Oscillation Start Voltage	V_{ST2}	Applied 0.8 V to V_{OUT}, Vpull = 1.0 V	-	-	0.8	V	②
Operating Hold Voltage	V_{HLD}	I_{OUT} = 1 mA, Connected to external components	0.7	-	-	V	①
Input Current at No Load	I_{IN}	I_{OUT} = 0 mA (*1)	-	E1-1(*)	E1-2(*)	μA	①
Supply Current 1 (*2)	I_{DD1}	Applied (output voltage x0.95) to V_{OUT}	-	E2-1(*)	E2-2(*)	μA	②
Supply Current 2	I_{DD2}	Applied (output voltage + 0.5) to V_{OUT}	-	E3-1(*)	E3-2(*)	μA	②
Lx Switch ON Resistance	R_{SWON}	Same as I_{DD1}, V_{Lx} = 0.4 V (*3)	-	E4-1(*)	E4-2(*)	Ω	②
Lx Leak Current	I_{LxL}	Same as I_{DD2}, V_{Lx} = 7 V	-	-	1	μA	③
Duty Ratio	DTY	Same as I_{DD1}, measure Lx waveform	E7-1(*)	E7-2(*)	E7-3(*)	%	②
Duty Ratio 2	DTY2	I_{OUT} = 1 mA, measure Lx ON time. Connect to external components	48	56	64	%	①
Maximum Oscillation Frequency	$MAXf_{OSC}$	Same as I_{DD1}	85	100	115	kHz	②
Maximum Oscillation Frequency 2	$MAXf_{OSC2}$	Same as I_{DD1}	153	180	207	kHz	②
Lx Limit Voltage (*4)	V_{LxLMT}	Same as I_{DD1}, V_{Lx} when max oscillation frequency is more than double	0.7	-	1.1	V	②
Efficiency (*5)	EFFI	Connect to external components	-	E8(*)	-	%	①

Test condition: Unless otherwise specified, connect V_{DD} to V_{OUT}, V_{IN}=V_{OUT} × 0.6, I_{OUT} ≤ C1 (*), Vpull = 5.0 V

NOTE:
*1: XBS104S14R-G is used; reverse current I_R < 1 μA (when reverse voltage V_R = 10 V is applied), in case of using selected parts.
*2: "Supply Current 1" is the value when the IC is constantly switching. In actual operation, the oscillator periodically switches, resulting in lower power consumption. Please refer to Input Current (I_{IN}) under no load condition for the actual current, which is supplied from the input power supply (V_{IN}).
*3: Lx switch ON resistance can be calculated by (V_{Lx} x Rp) / (Vpull - V_{Lx}). * Change Vpull so that V_{Lx} will become 0.4 V.
*4: The Lx limit voltage function becomes stable when V_{OUT} of the IXD2110/111 series is over 2.0 V.
*5: EFFI = {[output voltage] × (output current)} / [(input voltage) × (input current)] ×100
*6: When using V_{DD} and V_{OUT} separately, please, set the voltage range of V_{DD} from 1.5 V to 10 V. The IC operates from V_{DD} = 0.8 V, but output voltage and oscillation frequency will be stable when V_{DD} = 1.5 V or more.
*7: Please be aware of the absolute maximum ratings of the external components.
(*): Please refer to the charts.

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

IXD2110Fxx1MR, IXD2111Fxx1MR

Ta = 25 ^{0}C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	Connected to external components	x 0.975	V_{OUT}	x 1.025	V	⑥
Output Voltage Temperature Characteristics	$\frac{\Delta Vout}{Vout * \Delta Topr}$	Connected to external components - 40 ^{0}C ≤ Topr ≤ 85 ^{0}C		± 100		ppm/^{0}C	⑥
Maximum Input Voltage	V_{IN}		10	-	-	V	
Operating Start Voltage	V_{ST1}	I_{OUT} = 1 mA, Connected to external components	-	0.8	0.9	V	⑥
Oscillation Start Voltage	V_{ST2}	Applied 0.8 V to V_{OUT}	-	-	0.8	V	⑦
Operating Hold Voltage	V_{HLD}	I_{OUT} = 1 mA, Connected to external components	0.7	-	-	V	⑥
Supply Current 1 (*1)	I_{DD1}	Applied (output voltage x0.95) to V_{OUT}	-	E2-1(*)	E2-2(*)	μA	⑦
Supply Current 2	I_{DD2}	Applied (output voltage + 0.5) to V_{OUT}	-	E3-1(*)	E3-2(*)	μA	⑦
EXT "H" ON Resistance	R_{EXTH}	Same as I_{DD1}, V_{EXT} = VOUT - 0.4 V (*2)	-	E5-1(*)	E5-2(*)	Ω	②
EXT "L" ON Resistance	R_{EXTL}	Same as I_{DD1}, V_{EXT} = 0.4 V (*3)	-	E6-1(*)	E6-2(*)	Ω	②
Duty Ratio	DTY	Same as I_{DD1}, measure Lx waveform	E7-1(*)	E7-2(*)	E7-3(*)	%	⑦
Duty Ratio 2	DTY2	I_{OUT} = 1 mA, measure Lx ON time. Connect to external components	48	56	64	%	⑥
Maximum Oscillation Frequency	$MAXf_{OSC}$	Same as I_{DD1}	85	100	115	kHz	⑦
Maximum Oscillation Frequency 2	$MAXf_{OSC2}$	Same as I_{DD1}	153	180	207	kHz	⑦
Efficiency (*4)	EFFI	Connect to external components	-	E9(*)	-	%	⑥

Test condition: Unless otherwise specified, connect V_{DD} to V_{OUT}, V_{IN} = V_{OUT} × 0.6, I_{OUT} ≤C1 (*)

NOTE:
*1: "Supply Current 1" is the value when the IC is constantly switching. In actual operation, the oscillator periodically switches, resulting in lower power consumption.
*2: EXT "H" ON resistance can be calculated by (0.4 x Rp) / (V_{EXT} - Vpull). * Change Vpull so that V_{EXT} will become V_{OUT} - 0.4 V.
*3: EXT "L" ON resistance can be calculated by (V_{EXT} x Rp) / (Vpull - V_{EXT}). * Change Vpull so that V_{EXT} will become 0.4 V.
*4: EFFI = {[output voltage] × (output current)} / [(input voltage) × (input current)] ×100
*5: When using V_{DD} and V_{OUT} separately, please, set the voltage range of V_{DD} from 1.5 V to 10 V. The IC operates from V_{DD} = 0.8V, but output voltage and oscillation frequency will be stable when V_{DD} = 1.5 V or more.
*6: Please be aware of the absolute maximum ratings of the external components.
(*): Please refer to the charts.

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

I_{DD2}, R_{EXTH}, R_{EXTL}, DTY CHART

<table>
<tr><td>SYMBOL</td><td>E2-1</td><td>E2-2</td><td>E1-1</td><td>E1-2</td><td>E3-1</td><td>E3-2</td><td>E4-1</td><td>E4-2</td><td>E5-1</td><td>E5-2</td><td>E6-1</td><td>E6-2</td></tr>
<tr><td>PARAMETER</td><td colspan="2">Supply Current 1</td><td colspan="2">Input Current (No Load)</td><td colspan="2">Supply Current 2</td><td colspan="2">Lx Switch ON Resistance</td><td colspan="2">EXT H ON Resistance</td><td colspan="2">EXT L ON Resistance</td></tr>
<tr><td>UNIT</td><td colspan="2">(µA)</td><td colspan="2">(µA)</td><td colspan="2">(µA)</td><td colspan="2">(Ω)</td><td colspan="2">(Ω)</td><td colspan="2">(Ω)</td></tr>
<tr><td rowspan="2">SETTING VOLTAGE</td><td colspan="2">I_{DD1}</td><td colspan="2">I_{IN}</td><td colspan="2">I_{DD2}</td><td colspan="2">R_{SWON}</td><td colspan="2">R_{EXTH}</td><td colspan="2">R_{EXTL}</td></tr>
<tr><td>TYP.</td><td>MAX.</td><td>TYP.</td><td>MAX.</td><td>TYP.</td><td>MAX.</td><td>TYP.</td><td>MAX.</td><td>TYP.</td><td>MAX.</td><td>TYP.</td><td>MAX.</td></tr>
<tr><td>1.5</td><td>7.7</td><td>15.1</td><td rowspan="6">4.3</td><td rowspan="6">8.6</td><td rowspan="6">1.9</td><td rowspan="5">3.5</td><td rowspan="4">4.2</td><td rowspan="4">6.3</td><td rowspan="4">160</td><td rowspan="4">240</td><td rowspan="4">67</td><td rowspan="4">101</td></tr>
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<tr><td>1.8</td><td>8.6</td><td>16.8</td></tr>
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<tr><td>2.4</td><td>11.0</td><td>21.5</td><td rowspan="3">4.5</td><td rowspan="3">9.1</td><td rowspan="3">4.1</td></tr>
<tr><td>2.5</td><td>11.5</td><td>22.5</td></tr>
<tr><td>2.6</td><td>12.0</td><td>23.5</td><td rowspan="6">2.8</td><td rowspan="6">4.2</td><td rowspan="6">70</td><td rowspan="6">105</td><td rowspan="6">38</td><td rowspan="6">57</td></tr>
<tr><td>2.7</td><td>12.5</td><td>24.5</td><td rowspan="4">4.6</td><td rowspan="4">9.3</td><td rowspan="7">2.1</td><td rowspan="4">4.2</td></tr>
<tr><td>2.8</td><td>13.1</td><td>25.6</td></tr>
<tr><td>2.9</td><td>13.7</td><td>26.8</td></tr>
<tr><td>3.0</td><td>14.3</td><td>28.0</td></tr>
<tr><td>3.1</td><td>15.0</td><td>29.3</td><td rowspan="3">4.7</td><td rowspan="3">9.5</td><td rowspan="3">4.3</td></tr>
<tr><td>3.2</td><td>15.7</td><td>30.6</td><td rowspan="21">2.5</td><td rowspan="21">3.8</td><td rowspan="21">59</td><td rowspan="21">89</td><td rowspan="21">33</td><td rowspan="21">50</td></tr>
<tr><td>3.3</td><td>16.4</td><td>31.9</td></tr>
<tr><td>3.4</td><td>17.1</td><td>33.3</td><td rowspan="3">4.8</td><td rowspan="3">9.7</td><td rowspan="7">2.2</td><td rowspan="3">4.4</td></tr>
<tr><td>3.5</td><td>17.8</td><td>34.8</td></tr>
<tr><td>3.6</td><td>18.6</td><td>36.3</td></tr>
<tr><td>3.7</td><td>19.4</td><td>37.9</td><td rowspan="4">5.0</td><td rowspan="4">10.0</td><td rowspan="4">4.5</td></tr>
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<tr><td>3.9</td><td>21.1</td><td>41.1</td></tr>
<tr><td>4.0</td><td>22.0</td><td>42.8</td></tr>
<tr><td>4.1</td><td>22.9</td><td>44.5</td><td rowspan="3">5.1</td><td rowspan="3">10.2</td><td rowspan="6">2.3</td><td rowspan="3">4.6</td></tr>
<tr><td>4.2</td><td>23.8</td><td>46.3</td></tr>
<tr><td>4.3</td><td>24.8</td><td>48.2</td></tr>
<tr><td>4.4</td><td>25.7</td><td>50.0</td><td rowspan="3">5.2</td><td rowspan="3">10.4</td><td rowspan="3">4.7</td></tr>
<tr><td>4.5</td><td>26.7</td><td>52.0</td></tr>
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<tr><td>4.7</td><td>28.8</td><td>56.0</td><td rowspan="4">5.3</td><td rowspan="4">10.6</td><td rowspan="7">2.4</td><td rowspan="4">4.8</td></tr>
<tr><td>4.8</td><td>29.8</td><td>58.0</td></tr>
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<tr><td>5.4</td><td>34.1</td><td>68.3</td><td rowspan="3">5.5</td><td rowspan="3">11.1</td><td rowspan="7">2.5</td><td rowspan="3">5.0</td></tr>
<tr><td>5.5</td><td>34.7</td><td>69.5</td></tr>
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<tr><td>5.7</td><td>36.0</td><td>72.0</td><td rowspan="4">5.6</td><td rowspan="4">11.3</td><td rowspan="4">5.1</td></tr>
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<tr><td>6.8</td><td>42.6</td><td>85.2</td></tr>
<tr><td>6.9</td><td>43.2</td><td>86.4</td></tr>
<tr><td>7.0</td><td>43.7</td><td>87.5</td></tr>
</table>

ELECTRICAL OPERATING CHARACTERISTICS (Continued)

I_{OUT}, DTY, EFFI CHART

<table>
<tr><td>SYMBOL</td><td>C1</td><td>E7-1</td><td>E7-2</td><td>E7-3</td><td colspan="2">E8</td><td colspan="2">E9</td></tr>
<tr><td rowspan="2">PARAMETER</td><td rowspan="5">OUTPUT CURRENT (mA) I_{OUT}</td><td colspan="3" rowspan="2">DUTY RATIO</td><td colspan="4">EFFICIENCY</td></tr>
<tr><td>IXD2110</td><td>IXD2111</td><td>IXD2110</td><td>IXD2111</td></tr>
<tr><td>UNIT</td><td colspan="3">(%)</td><td colspan="4">(%)</td></tr>
<tr><td rowspan="2">SETTING VOLTAGE</td><td colspan="3">DTY</td><td colspan="4">EFFI</td></tr>
<tr><td>MIN.</td><td>TYP.</td><td>MAX.</td><td colspan="4">TYP.</td></tr>
<tr><td>1.5</td><td>7.5</td><td rowspan="37">70</td><td rowspan="37">75</td><td rowspan="37">80</td><td rowspan="5">60</td><td rowspan="5">75</td><td rowspan="5">60</td><td rowspan="5">75</td></tr>
<tr><td>1.6</td><td>8.0</td></tr>
<tr><td>1.7</td><td>8.5</td></tr>
<tr><td>1.8</td><td>9.0</td></tr>
<tr><td>1.9</td><td>9.5</td></tr>
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<tr><td>2.4</td><td>12.0</td></tr>
<tr><td>2.5</td><td>12.5</td></tr>
<tr><td>2.6</td><td>13.0</td></tr>
<tr><td>2.7</td><td>13.5</td></tr>
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<tr><td>2.9</td><td>14.5</td></tr>
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<tr><td>3.3</td><td>33.0</td></tr>
<tr><td>3.4</td><td>34.0</td></tr>
<tr><td>3.5</td><td>35.0</td></tr>
<tr><td>3.6</td><td>36.0</td></tr>
<tr><td>3.7</td><td>37.0</td></tr>
<tr><td>3.8</td><td>38.0</td></tr>
<tr><td>3.9</td><td>39.0</td></tr>
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<tr><td>4.1</td><td>41.0</td></tr>
<tr><td>4.2</td><td>42.0</td></tr>
<tr><td>4.3</td><td>43.0</td></tr>
<tr><td>4.4</td><td>44.0</td></tr>
<tr><td>4.5</td><td>45.0</td></tr>
<tr><td>4.6</td><td>46.0</td></tr>
<tr><td>4.7</td><td>47.0</td></tr>
<tr><td>4.8</td><td>48.0</td></tr>
<tr><td>4.9</td><td>49.0</td></tr>
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<tr><td>5.3</td><td>53.0</td></tr>
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<tr><td>5.5</td><td>55.0</td></tr>
<tr><td>5.6</td><td>56.0</td></tr>
<tr><td>5.7</td><td>57.0</td></tr>
<tr><td>5.8</td><td>58.0</td></tr>
<tr><td>5.9</td><td>59.0</td></tr>
<tr><td>6.0</td><td>60.0</td></tr>
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<tr><td>6.2</td><td>62.0</td></tr>
<tr><td>6.3</td><td>63.0</td></tr>
<tr><td>6.4</td><td>64.0</td></tr>
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<tr><td>6.6</td><td>66.0</td></tr>
<tr><td>6.7</td><td>67.0</td></tr>
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<tr><td>6.9</td><td>69.0</td></tr>
<tr><td>7.0</td><td>70.0</td></tr>
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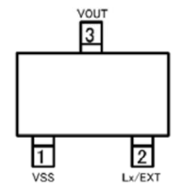
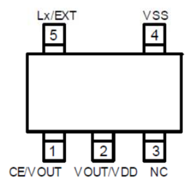
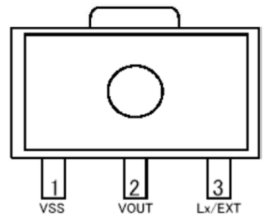
PIN CONFIGURATION



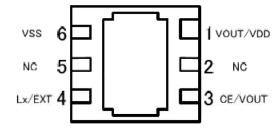
SOT-23 (TOP VIEW)



SOT-25 (TOP VIEW)



SOT-89 (TOP VIEW)



USP-6C (BOTTOM VIEW)

The dissipation pad for the USP-6C package should be solder-plated in recommended mount pattern and metal masking to enhance mounting strength and heat release. If the pad

PIN ASSIGNMENT

IXD2111A/B

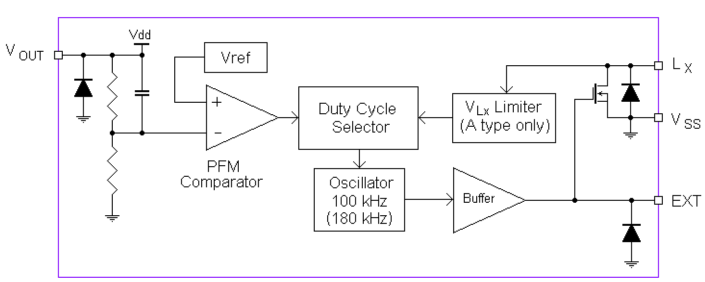
PIN NUMBER				PIN NAME	FUNCTIONS
SOT-23		SOT-89			
A	B	A	B		
1	1	1	1	V_{SS}	Ground
3	3	2	2	V_{OUT}	Output Voltage Monitor, Internal Power Supply Input
2	-	3	-	L_X	Switch
-	2	-	3	EXT	External Switching transistor drive, Connect to the gate of N-channel transistor

IXD2110//111C/D/E/F

PIN NUMBER								PIN NAME	FUNCTIONS
SOT-25				USP-6C					
C	D	E	F	C	D	E	F		
-	-	2	2	-	-	1	1	V_{DD}	Internal Power Supply Input
4	4	4	4	6	6	6	6	V_{SS}	Ground
-	5	-	5	-	4	-	4	EXT	External Switching transistor drive, Connect to the gate of N-channel transistor
5	-	5	-	4	-	4	-	Lx	Switch
1	1	-	-	3	3	-	-	CE	Chip Enable, Connect to the V_{OUT} pin when Active and the V_{SS} in standby mode
2	2	1	1	1	1	3	3	V_{OUT}	Output Voltage Monitor
3	3	3	3	2, 5	2, 5	2, 5	2, 5	NC	No connection

BLOCK DIAGRAMS

IXD2111A and B Series



Note:

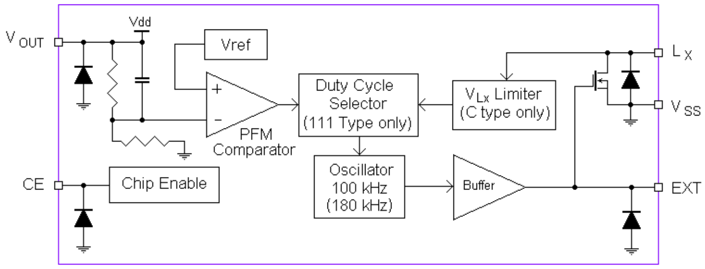
The IXD2111 series with built-in transistor use the Lx pin and the IXD2111 series with external transistor use the EXT pin.

The duty ratio of the IXD2111 series automatically varies between 56% at oscillation frequency 180 kHz and 75% at oscillation frequency (f_{OSC}) 100 kHz.

The V_{Lx} limit function applies to the IXD2111A types only.

* The duty ratio depends on power supply. Please refer to the electrical characteristics on duty cycle against output voltage you use.

IXD2110/111C and D series



Note:

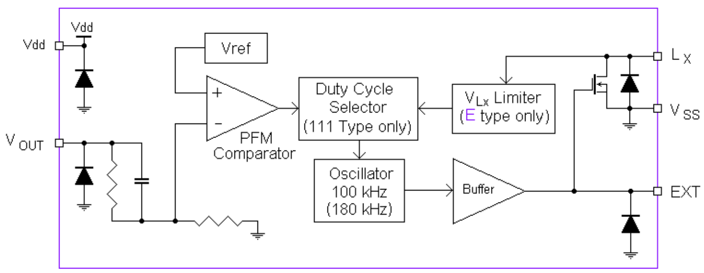
The IXD2110/111 series with built-in transistor use the Lx pin and the IXD2110/111 series with external transistor use the EXT pin.

The IXD2110 series' duty cycle ratio is 75% at oscillation frequency (f_{OSC}) 100 kHz. The duty cycle ratio of the IXD2111 series automatically varies between 56% at frequency 180 kHz and 75% at oscillation frequency (f_{OSC}) 100 kHz.

The VLx limit function only applies to the IXD2110/111 C versions.

* The duty ratio depends on power supply. Please refer to the electrical characteristics on duty cycle against output voltage you use.

IXD2110/111C and D series



Note:

The IXD2110/111 series with built-in transistor uses the Lx pin and the IXD2110/111 series with external transistor use the EXT pin.

The IXD2110 / 111 series E and F have the V_{DD} pin.

The IXD2110 series' duty cycle ratio is 75% at oscillation frequency (f_{OSC}) 100 kHz. The duty ratio of the IXD2111 series automatically varies between 56% at oscillation frequency 180 kHz and 75% at oscillation frequency (f_{OSC}) 100 kHz.

The VLx limit function applies to the IXD2110/111 C versions only.

* The duty ratio depends on power supply. Please refer to the electrical characteristics on duty cycle against output voltage you use.

BASIC OPERATION

The IXD2110/111 series are PFM mode step-up DC/DC converters (A, C and E types) / controllers ICs (B, D and F types), which contain voltage reference source Vref, PFM Comparator, Duty Cycle Selector, PFM controlled Oscillator, V_{Lx} Voltage Limiter, Buffer, and MOSFET transistor.

Maximum duty cycle ratio of 75% at oscillation frequency 100 kHz for IXD2110 series makes it suitable for use with large load current.

The IXD2111 series automatically switches duty cycle ratio between 56% at oscillation frequency 180 kHz and 75% at oscillation frequency 100 kHz, when it senses changes in load, and it can support both large and small load currents.

Reference Voltage Source (Vref)

The reference voltage source provides the reference voltage to ensure stable output voltage of the DC/DC converter.

PFM Comparator

The PFM comparator compares the feedback voltage divided by the internal resistive divider with the internal reference voltage. When the feedback voltage is higher than the reference voltage, PFM controlled oscillator will be stopped. When the feedback voltage is lower than the reference voltage, the PFM controlled oscillator sends through buffer a signal to the internal or external switching transistor to keep output voltage stable.

Duty Cycle Selector

With the IXD2111 series, the duty cycle selector automatically switches duty cycle ratio between 56% and 75% when it senses changes in load to support both large and small currents.

PFM Controlled Oscillator

The PFM controlled oscillator determines maximum oscillation frequency. The circuit generates the oscillation frequency of 100 kHz at 75% duty cycle and 180 kHz at 56%.

V_{Lx} Voltage Limiter

The V_{Lx} circuits of the ISD110/111 A, C, and D types detect in-rush current and over-current, which flows from the V_{OUT} pin to the Lx pin. In case of over-current, the switching transistor will be OFF. When the over-current condition removed, the IC resumes its normal operation.

Chip Enable Function

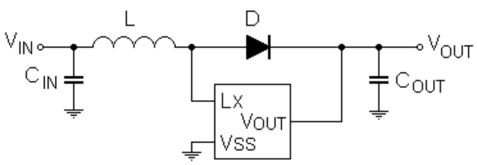
The chip enable function of the IXD2110/111 C and D types sends IC into shut down mode, when CE pin is logic low. The current consumption in shutdown mode is less than 0.5 µA.

Separated V_{DD}/V_{OUT}

Additional V_{DD} pin allows IXD2110/111 E and F types operate with V_{OUT} voltage higher or lover than V_{DD} voltage reguired for stable IC operations.

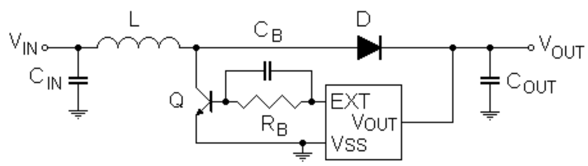
TYPICAL APPLICATION CIRCUITS

A type IC



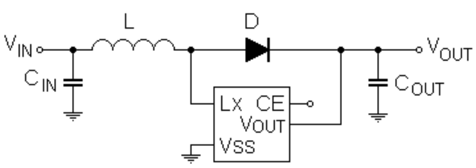
L – 100µH (Coil, CR54, SUMIDA)
D – XBS104S14R-G (Schottky type, TOREX)
C_{OUT} – 16V, 47µF (Tantalum)
C_{IN} – 16V, 47µF (Tantalum)

B type IC



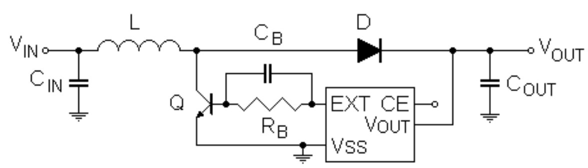
L = 47µH (Coil, CR54, SUMIDA)
D XBS104S14R-G (Schottky type, TOREX)
C_{OUT} – 16V, 47µF (Tantalum)
C_{IN} – 16V, 47µF (Tantalum)
R_B – 500Ω
C_B – 2200pF
Q – 2SD1628 (Sanyo)

C type IC



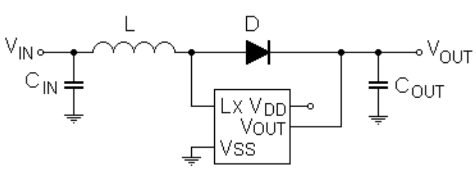
L – 100µH (Coil, CR54, SUMIDA)
D – XBS104S14R-G (Schottky type, TOREX)
C_{OUT} – 16V, 47µF (Tantalum)
C_{IN} – 16V, 47µF (Tantalum)

D type IC



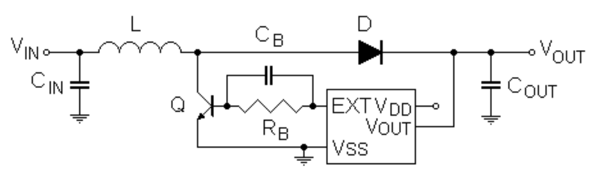
L = 47µH (Coil, CR54, SUMIDA)
D XBS104S14R-G (Schottky type, TOREX)
C_{OUT} – 16V, 47µF (Tantalum)
C_{IN} – 16V, 47µF (Tantalum)
R_B – 500Ω
C_B – 2200pF
Q – 2SD1628 (Sanyo)

E type IC



L – 100µH (Coil, CR54, SUMIDA)
D – XBS104S14R-G (Schottky type, TOREX)
C_{OUT} – 16V, 47µF (Tantalum)
C_{IN} – 16V, 47µF (Tantalum)

F type IC



L = 47µH (Coil, CR54, SUMIDA)
D XBS104S14R-G (Schottky type, TOREX)
C_{OUT} – 16V, 47µF (Tantalum)
C_{IN} – 16V, 47µF (Tantalum)
R_B – 500Ω
C_B – 2200pF
Q – 2SD1628 (Sanyo)

EXTERNAL COMPONENTS

The IXD2110/111 B/D/F type allows use of the n-channel MOSFET or n-p-n transistor as external switch.

In case of a MOSFET, recommended type is XP151A13A0MR-G from TOREX.

Note:

V_{GS} breakdown voltage of this transistor is 8 V. If the power supply voltage is above 6 V use XP151A12A2MR-G with a V_{GS} breakdown voltage of 12 V.

In case of n-p-n transistor, recommended type is 2SD1628 from SANYO with R_B 500 Ω (Adjust in accordance with load and transistors h_{FE}.), and C_B 2200pF. $C_B \leq 1 / (2TT \times R_B \times F_{OSC} \times 0.7)$

Recommended R_B values for low input voltages are show in the table below.

R_B value examples for n-p-n transistor

V_{OUT} (V)	I_{OUT} (mA)	V_{IN} (V)	R_B (Ω)	V_{OUT} (V)	I_{OUT} (mA)	V_{IN} (V)	R_B (Ω)
1.8	10	1.2	4.5	3.3	5	1.2	6.5
1.8	10	1.5	6.0	3.3	5	1.5	6.5
1.8	30	1.2	2.0	3.3	10	1.2	5.0
1.8	30	1.5	2.0	3.3	10	1.5	4.5
1.8	50	1.2	1.2	3.3	30	1.2	3.5
1.8	50	1.5	1.5	3.3	30	1.5	3.5

Other recommended components are:

Diodes XBS104S14R-G from TOREX, or MA2Q735 from MATSUSHITA

Output capacitor C_{OUT} 16V, 47 µF TAJ type from KYOCERA

Input capacitor C_{IN} 16V, 47 µF TAJ type from KYOCERA, or 16V, 220 µF (electrolytic capacitor)

Inductor L for IXD2110/111A, C, and E series with built-in transistor 100 µH CR54, or CDRH6D28 type from SUMIDA

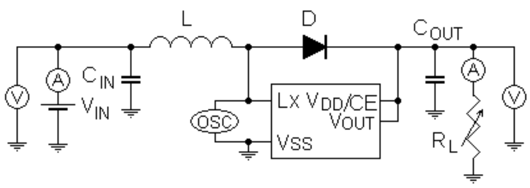
Inductor L for IXD2110/111B, D, and F series with external transistor 22 µH or 47µH CR54 type from SUMIDA

LAYOUT AND USE CONSIDERATIONS

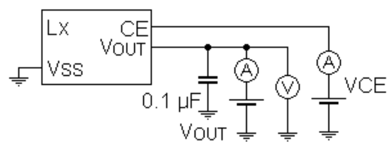
1. Please, do not exceed the value of stated absolute maximum ratings.
2. The DC/DC converter / controller IC's performance is greatly influenced by not only the ICs' characteristics, but also by those of the external components. Care must be taken when selecting external components.
3. The Lx limit voltage function becomes stable when V_{OUT} of the IXD2110/111C series is over 2.0V and the V_{DD} of the IXD2110/111E series is over 2.0V.
4. Make sure that the PCB ground traces are as thick as possible, as variations in ground potential caused by high ground currents at the time of switching may result in instability of the IC.
5. Please, mount each external component as close to the IC as possible and use thick, short connecting traces to reduce the circuit impedance.

TEST CIRCUITS

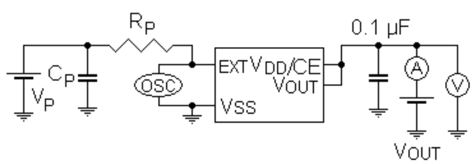
Circuit ①



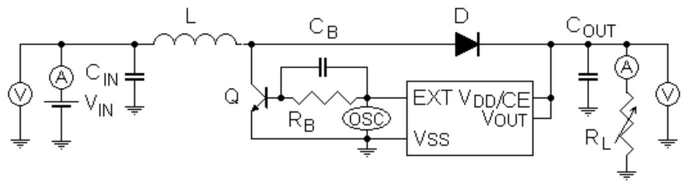
Circuit ⑤



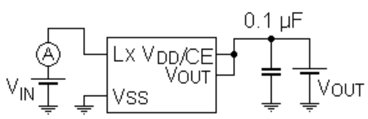
Circuit ②



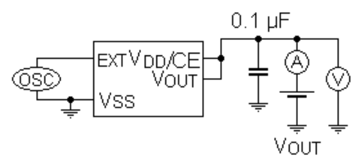
Circuit ⑥



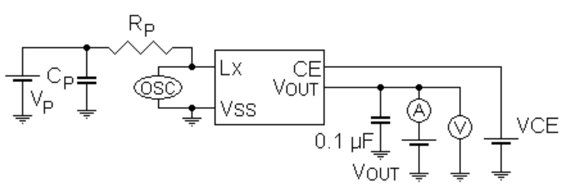
Circuit ③



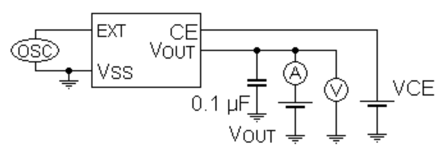
Circuit ⑦



Circuit ④



Circuit ⑧



External Components

Circuit ①
C_{IN} = 47 µF, 16V (Tantalum)
L = 100 µH, CR54 (SUMIDA)
D - XBS104S14R-G (Schottky, TOREX)
C_L = 47µF, 16V (Tantalum)

Circuit②
Rp = 300Ω
Rp = 10Ω (For Lx ON Resistance and Lx Current Limit Measurement)
Rp = 200 Ω (For measuring EXT ON Resistance)
Cp = 100 µF (OS-CON, SANYO)

Circuit ④
Cp: 100µF (OS-CON, SANYO)

Circuit ⑥
C_{IN} = 47 µF, 16V (Tantalum)
L = 100 µH, CR54 (SUMIDA)
Q - 2SD1628 (SANYO)
C_B = 2200pF
R_B = 500Ω
D - XBS104S14R-G (Schottky, TOREX)
C_L = 47µF, 16V (Tantalum

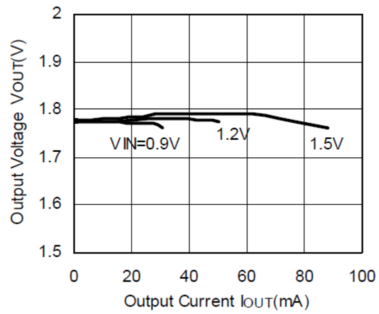
TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

Topr = 25 ^{0}C

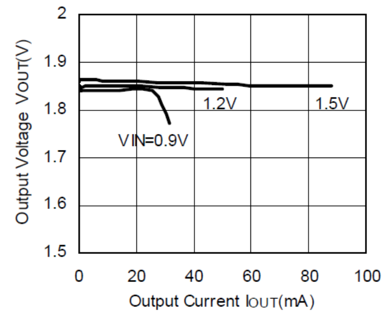
IXD2111E181MR

L = 100uH (CR54), C_L= 47uF (Tantalum), D - XBS104S14R



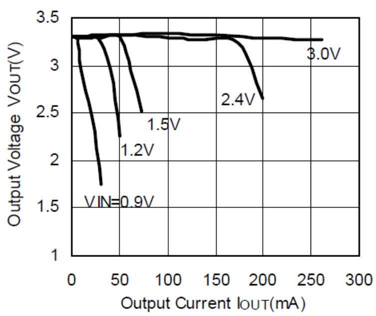
IXD2110E181MR

L = 100uH (CR54), C_L= 47uF (Tantalum), D - XBS104S14R



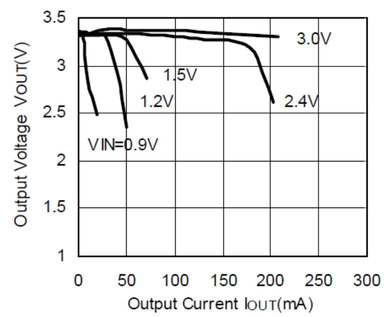
IXD2111E331MR

L = 100uH (CR54), C_L= 47uF (Tantalum), D - XBS104S14R



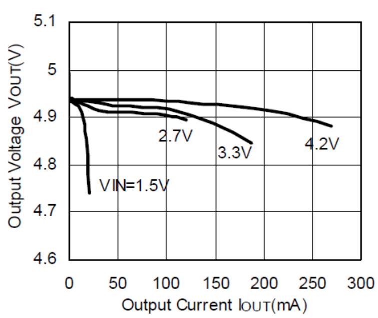
IXD2110E331MR

L = 100uH (CR54), C_L= 47uF (Tantalum), D - XBS104S14R



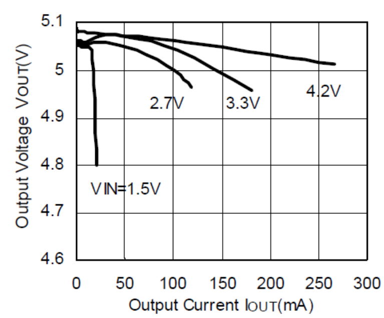
IXD2111E501MR

L = 100uH (CR54), C_L= 47uF (Tantalum), D - XBS104S14R



IXD2110E501MR

L = 100uH (CR54), C_L= 47uF (Tantalum), D - XBS104S14R



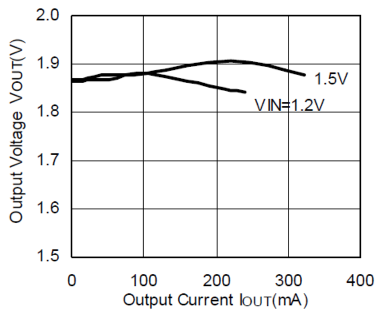
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(1) Output Voltage vs. Output Current

Topr = 25 ^{0}C

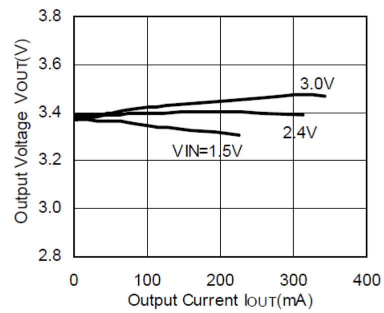
IXD2111F181MR

L = 22 μH (CR54), C_L = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A13A0M



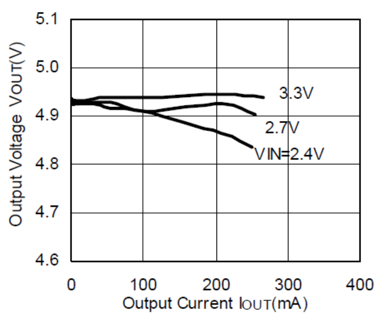
IXD2111F331MR

L = 22 μH (CR54), C_L = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A13A0M



IXD2111F501MR

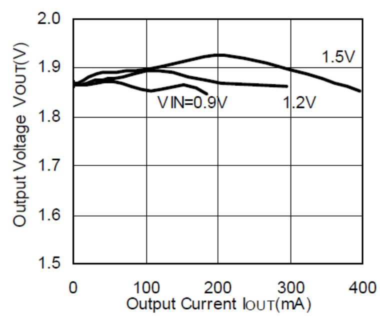
L = 22 μH(CR54), C_L = 47 μF(Tantalum), D - XBS104S14R,Q - XP151A12A2M



IXD2111F181MR

L = 22 μH (CR54), C_L = 47 μF (Tantalum), C_B = 2200pF, R_B = 100 Ω,

D - XBS104S14R, Q - 2SD1628,



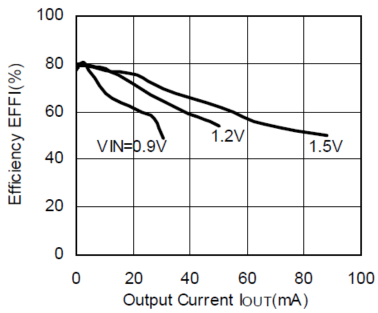
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Efficiency vs. Output Current

Topr = 25 ^{0}C

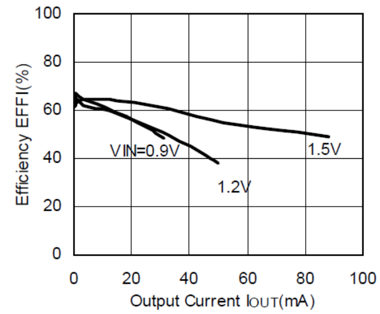
IXD2111E181MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



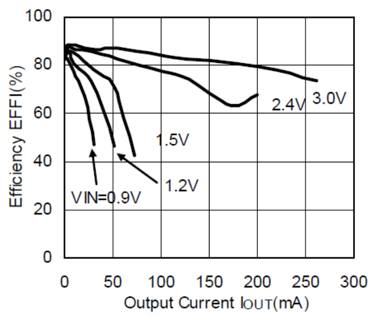
IXD2110E181MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



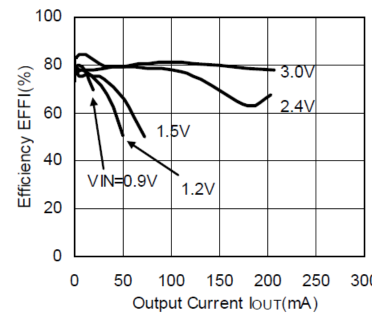
IXD2111E331MR

L = 100 µH (CR54), C_L = 47 µF(Tantalum), D - XBS104S14R



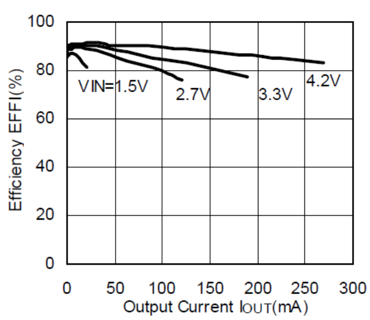
IXD2110E331MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



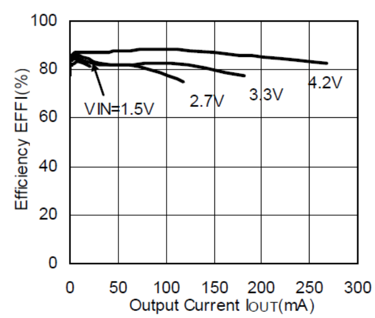
IXD2111E501MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



IXD2110E501MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



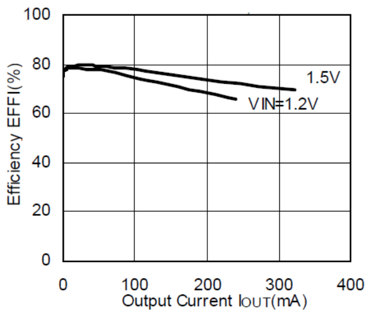
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Efficiency vs. Output Current

Topr = 25 ^{0}C

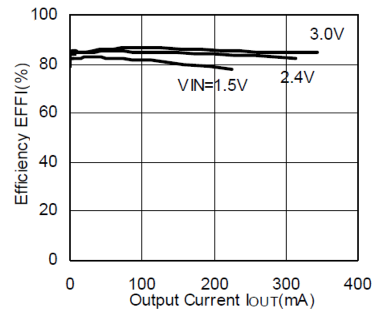
IXD2111F181MR

L= 22 μH (CR54), C_L = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A13A0M



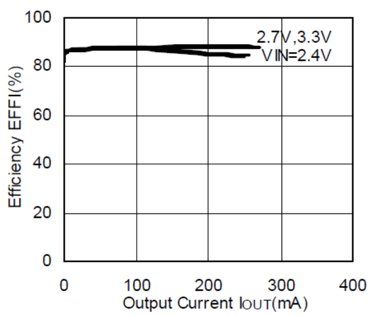
IXD2111F331MR

L= 22 μH (CR54), CL = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A13A0M



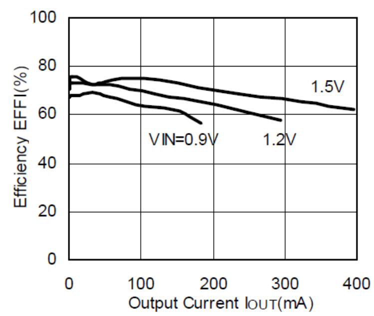
IXD2111F501MR

L = 22 μH (CR54), C_L = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A12A2M



IXD2111F181MR

L = 22 μH (CR54), C_L = 47 μF (Tantalum), C_B = 2200pF, R_B = 100 Ω,
D - XBS104S14R, Q - 2SD1628



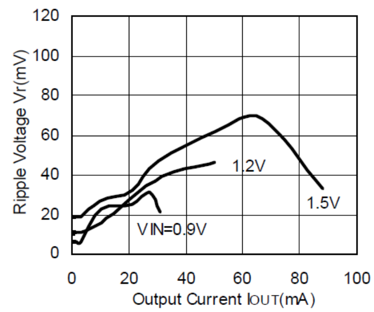
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3) Ripple Voltage vs. Output Current

Topr = 25 ^{0}C

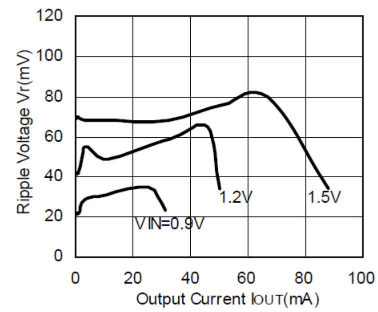
IXD2111E181MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



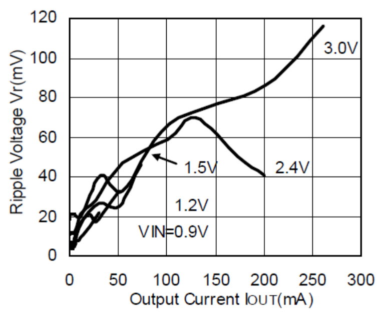
IXD2110E181MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



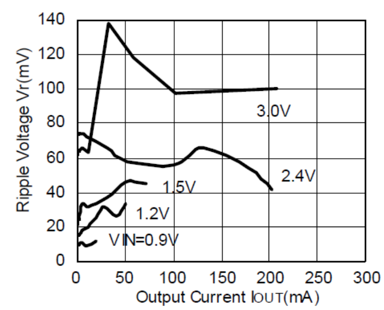
IXD2111E331MR

L = 100 µH (CR54), C_L = 47 µF(Tantalum), D - XBS104S14R



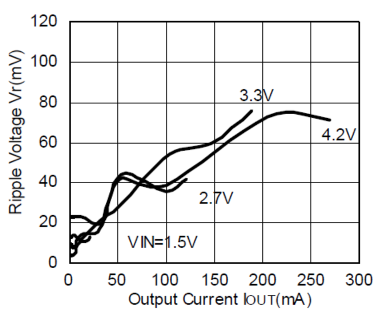
IXD2110E331MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



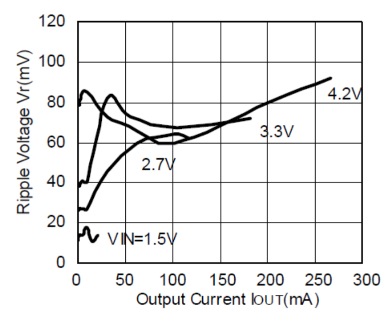
IXD2111E501MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



IXD2110E501MR

L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R

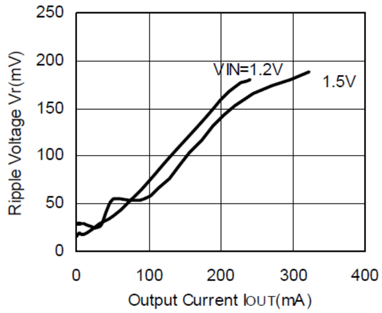


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(2) Ripple Voltage vs. Output Current Topr = 25 ⁰C

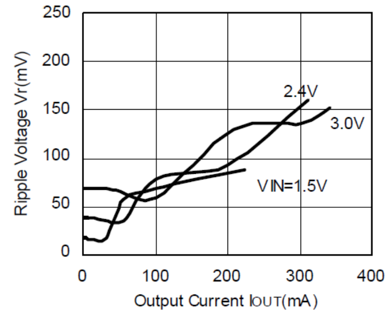
IXD2111F181MR

L= 22 μH (CR54), C_L = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A13A0M



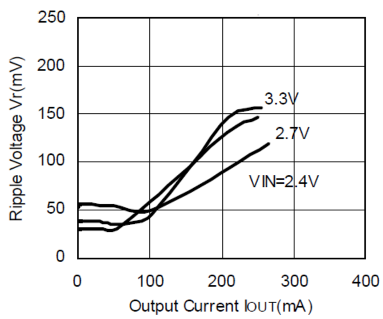
IXD2111F331MR

L= 22 μH (CR54), CL = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A13A0M



IXD2111F501MR

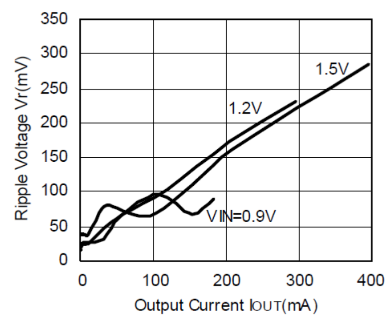
L = 22 μH (CR54), C_L = 47 μF (Tantalum), D - XBS104S14R, Q - XP151A12A2M



IXD2111F181MR

L = 22 μH (CR54), C_L = 47 μF (Tantalum), C_B = 2200pF, R_B = 100 Ω,

D - XBS104S14R, Q - 2SD1628

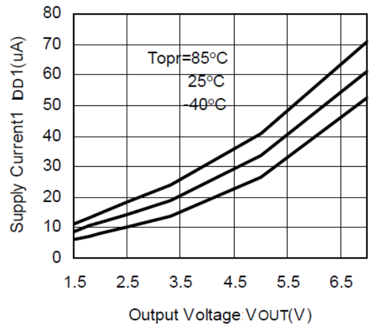


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(4) Supply Current 1 vs. Output Voltage

IXD2111xx1

$V_{DD} = V_{OUT} \times 0.95$

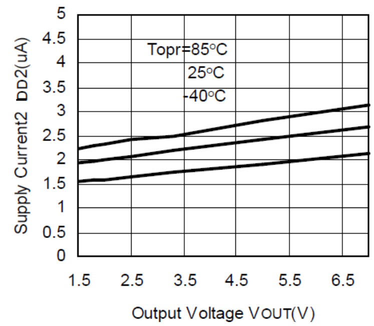


(5) Supply Current 2 vs. Output Voltage

Topr = 25 ^{0}C

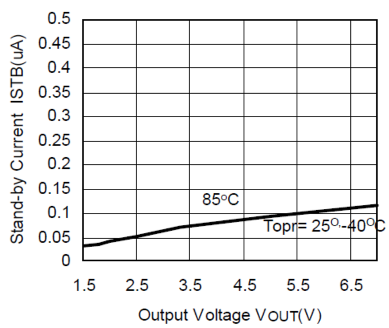
IXD2111xx1

$V_{DD} = V_{OUT} \times 0.5$



(6) Standby Current vs. Output Voltage

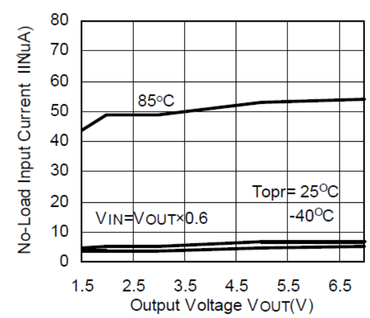
IXD2111E331MR



(7) No Load Input Current vs. Output Voltage

IXD2110E331MR

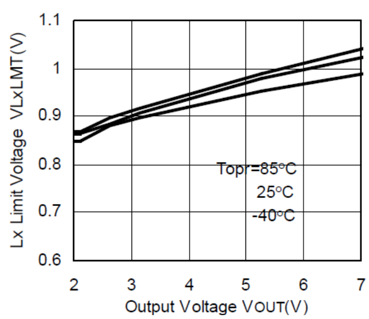
L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



(8) Lx Limit Voltage vs. Output Voltage

IXD2111E501MR

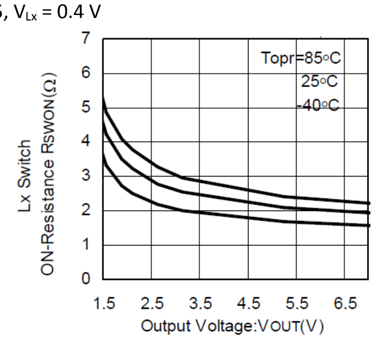
$V_{DD} = V_{OUT} \times 0.95$



(9) Lx Switch ON Resistance vs. Output Voltage

IXD2110E501MR

$V_{DD} = V_{OUT} \times 0.95$, $V_{Lx} = 0.4$ V

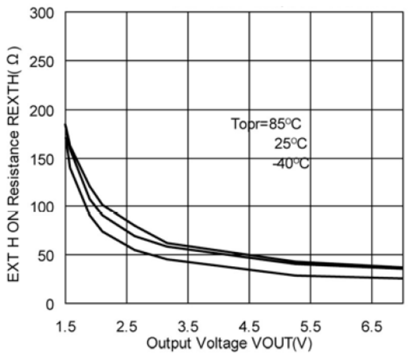


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(10) EXT "H" ON Resistance vs. Output Voltage

IXD2111Fxx1

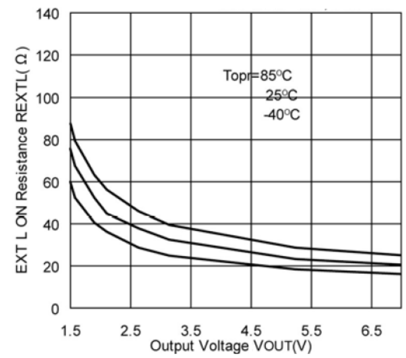
$V_{DD} = V_{OUT} \times 0.95$, $V_{EXT} = V_{OUT} - 0.4$ V



(11) EXT "L" ON Resistance vs. Output Voltage Topr = 25 °C

IXD2111Fxx1

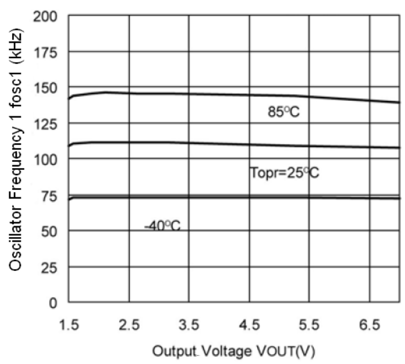
$V_{DD} = V_{OUT} \times 0.5$, $V_{EXT} = 0.4$ V



(12) Maximum Oscillation Frequency 1 vs. Output Voltage

IXD2111Exx1

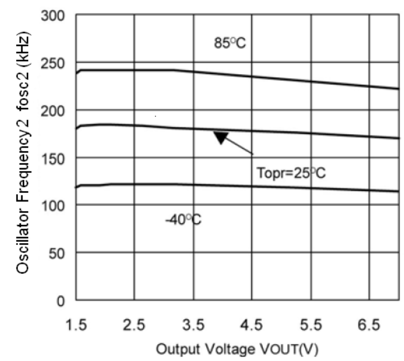
$V_{DD} = V_{OUT} \times 0.95$



(13) Maximum Oscillation Frequency 2 vs. Output Voltage

IXD2111Exx1

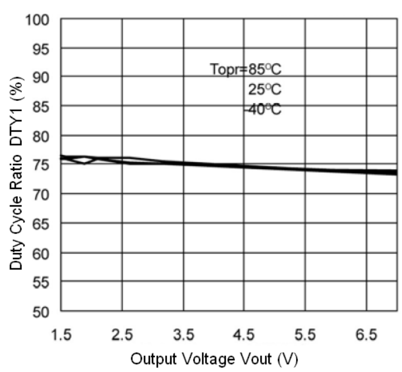
$V_{DD} = V_{OUT} \times 0.95$



(14) Duty Cycle Ratio 1 vs. Output Voltage

IXD2111Exx1

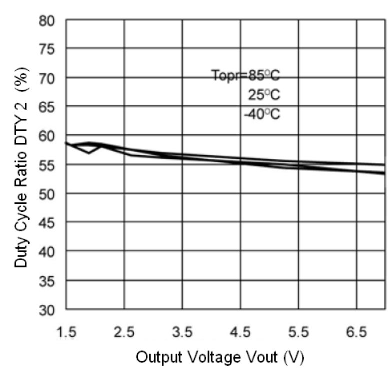
$V_{DD} = V_{OUT} \times 0.95$



(15) Duty Cycle Ratio 2 vs. Output Voltage

IXD2111Exx1

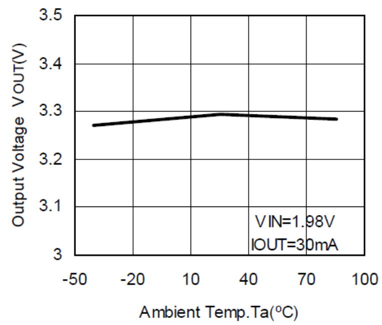
$V_{DD} = V_{OUT} \times 0.95$



TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(16) Output Voltage vs. Ambient Temperature

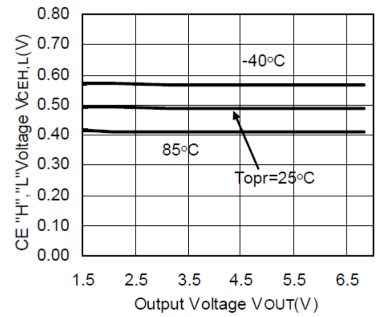
IXD2111E331



(17) CE “H” “L” Voltage vs. Output Voltage Topr = 25 ^{0}C

IXD2111Cxx1

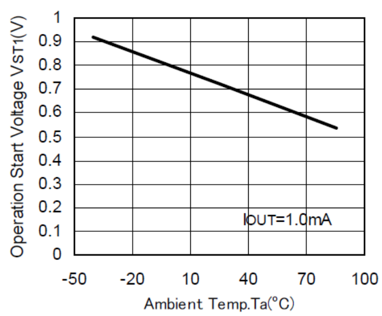
$V_{DD} = V_{OUT} \times 0.5$



(18) Operation Start Voltage vs. Ambient Temperature

IXD2111E331

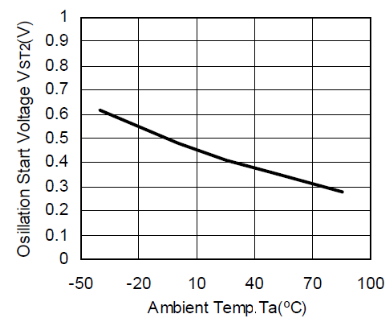
L = 100 µH (CR54), C_L = 47 µF (Tantalum), D - XBS104S14R



(19) Oscillation Start Voltage vs. Ambient Temperature

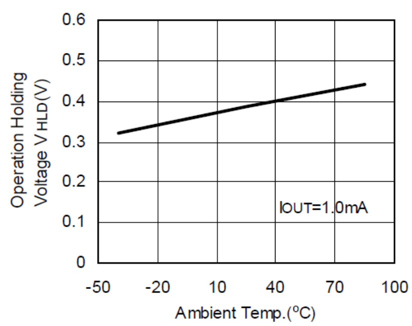
IXD2111E331

V_{OUT} = 0.8 V



(20) Operation Hold Voltage vs. Ambient Temperature

IXD2111E331



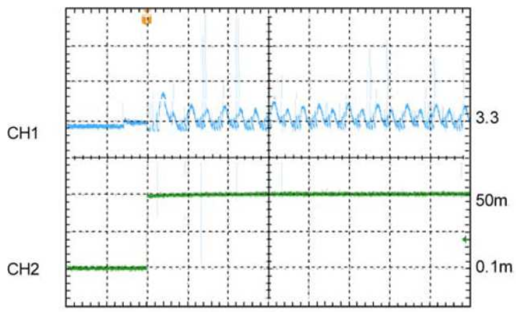
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(21) Load Transient Response

Topr = 25 ^{0}C

IXD2111E331

V_{IN} = 2.4 V, V_{DD} = V_{OUT}, I_{OUT} = 0.1 – 50 mA



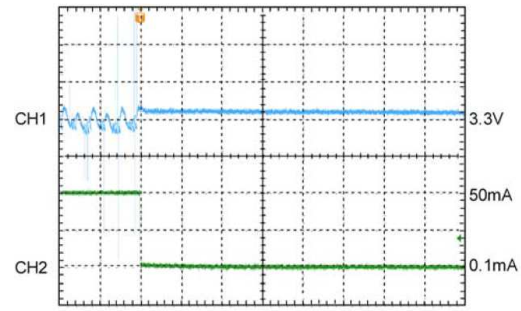
100µsec/div

Ch1 – V_{OUT} (AC-Coupled), 50 mV/div

Ch2 – I_{OUT}, 25 mA/div

IXD2111E331

V_{IN} = 2.4 V, V_{DD} = V_{OUT}, I_{OUT} = 0.1 – 50 mA



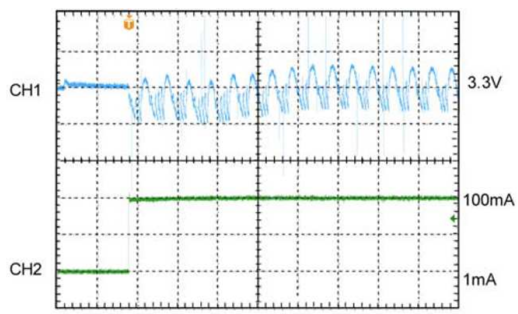
100µsec/div

Ch1 – V_{OUT} (AC-Coupled), 50 mV/div

Ch2 – I_{OUT}, 25 mA/div

IXD2111E331

V_{IN} = 2.4 V, V_{DD} = V_{OUT}, I_{OUT} = 1 – 100 mA



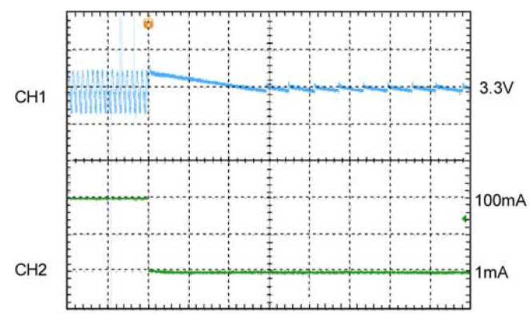
100µsec/div

Ch1 – V_{OUT} (AC-Coupled), 50 mV/div

Ch2 – I_{OUT}, 50 mA/div

IXD2111E331

V_{IN} = 2.4 V, V_{DD} = V_{OUT}, I_{OUT} = 1 – 100 mA



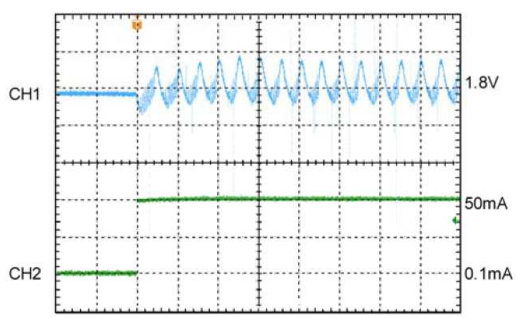
400µsec/div

Ch1 – V_{OUT} (AC-Coupled), 50 mV/div

Ch2 – I_{OUT}, 50 mA/div

IXD2111E181

V_{IN} = 1.5 V, V_{DD} = V_{OUT}, I_{OUT} = 0.1 – 50 mA



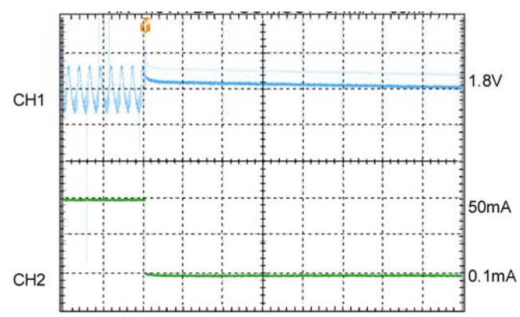
200µsec/div

Ch1 – V_{OUT} (AC-Coupled), 50 mV/div

Ch2 – I_{OUT}, 25 mA/div

IXD2111E181

V_{IN} = 1.5 V, V_{DD} = V_{OUT}, I_{OUT} = 0.1 – 50 mA



400µsec/div

Ch1 – V_{OUT} (AC-Coupled), 50 mV/div

Ch2 – I_{OUT}, 25 mA/div

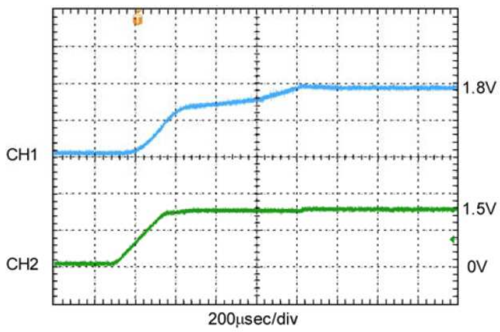
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(22) Input Transien Response

Topr = 25 ^{0}C

IXD2111E181

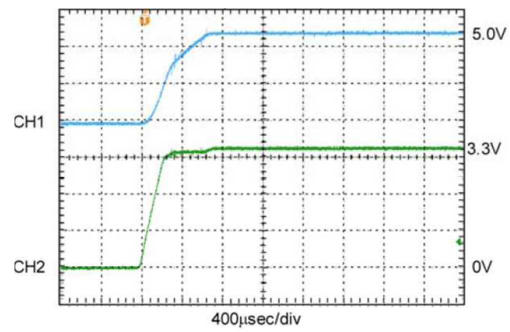
V_{IN} = 0 – 1.5 V, V_{DD} = V_{OUT}, I_{OUT} = 10 mA



Ch1 – V_{OUT}, 1.0 V/div; Ch2 – V_{IN}, 1.0 V/div

IXD2111E501

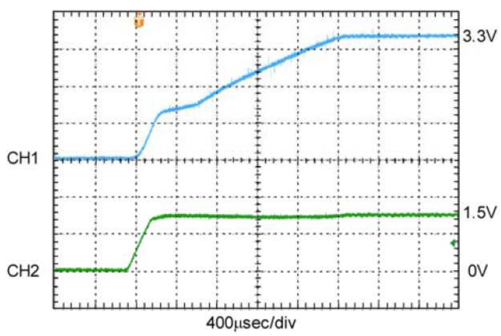
V_{IN} = 0 – 3.3 V, V_{DD} = V_{OUT}, I_{OUT} = 50 mA



Ch1 – V_{OUT}, 2.0 V/div; Ch2 – V_{IN}, 1.0 V/div

IXD2111E331MR

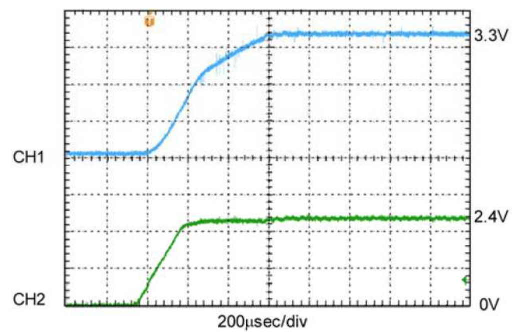
V_{IN} = 0 – 1.5 V, V_{DD} = V_{OUT}, I_{OUT} = 20 mA



Ch1 – V_{OUT}, 1.0 V/div; Ch2 – V_{IN}, 1.0 V/div

IXD2111E331

V_{IN} = 0 – 2.4 V, V_{DD} = V_{OUT}, I_{OUT} = 50 mA



Ch1 – V_{OUT}, 1.0 V/div; Ch2 – V_{IN}, 1.0 V/div

ORDERING INFORMATION

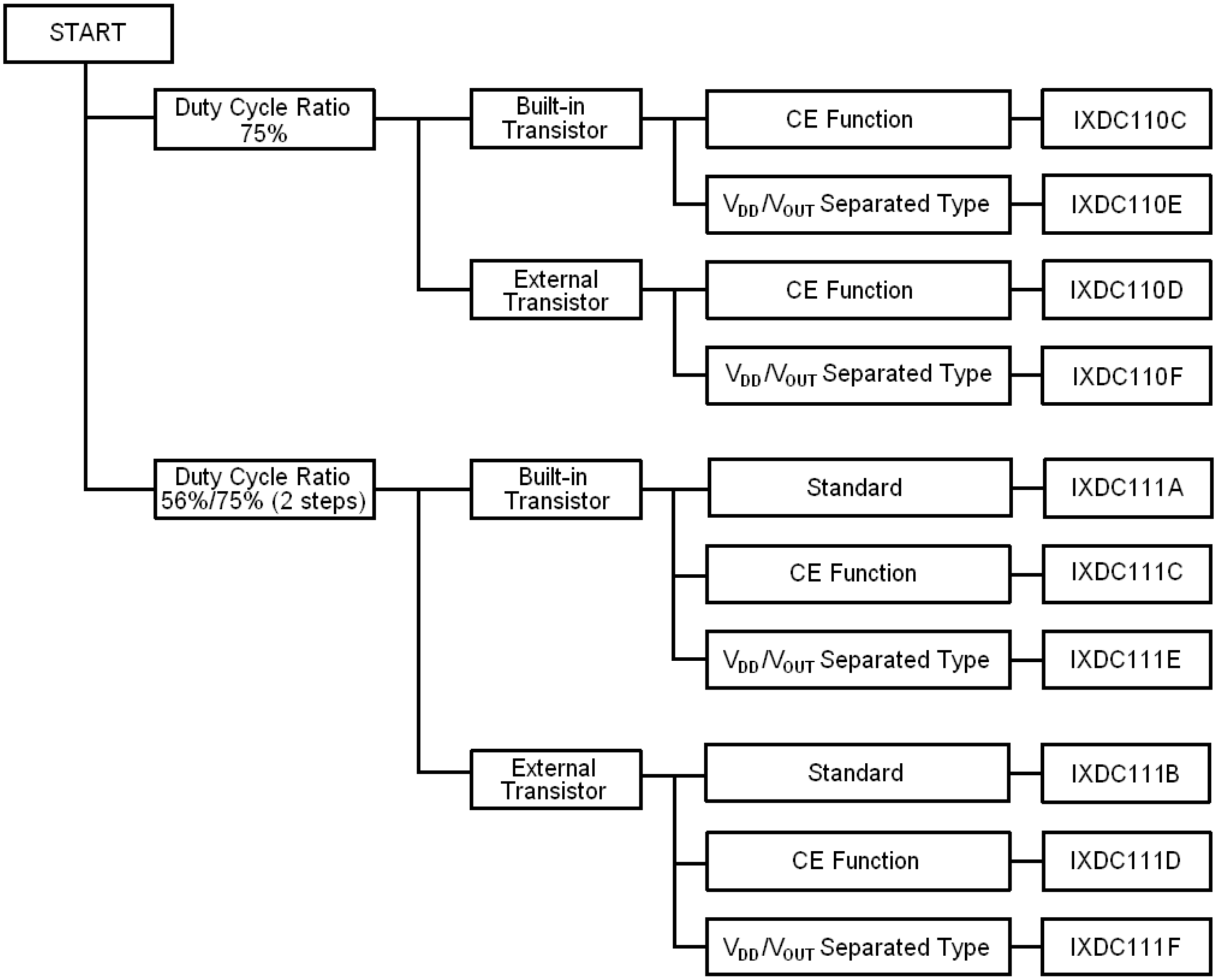
IXD2110①②③④⑤⑥-⑦ – PFM control, 75% duty

IXD2111①②③④⑤⑥-⑦ – PFM control, 56% / 75% duty variable

DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION	
①	CE Function	A	V_{DD} / V_{OUT} common type (for IXD2111 series)	Built-in Transistor
		B	V_{DD} / V_{OUT} common type (for IXD2111 series)	External Transistor
		C	CE pin (5 pin)	Built-in Transistor
		D	CE pin (5 pin)	External Transistor
		E	V_{DD} / V_{OUT} separated type (5 pin)	Built-in Transistor
		F	V_{DD} / V_{OUT} separated type (5 pin)	External Transistor
②③	Output Voltage	15 ~ 70	example 3.5V output - ② = 3, ③ = 5	
④	Maximum Oscillation Frequency	1	100kHz	
⑤⑥-⑦*	Packages (Order Limit)	MR	① = A～B SOT-23 (3,000/Reel)	
			① = C～F SOT-25 (3,000/Reel)	
		MR-G	① = A～B SOT-23 (3,000/Reel)	
			① = C～F SOT-25 (3,000/Reel)	
		PR	① = A～B SOT-89 (1,000/Reel)	
		PR-G	① = A～B SOT-89 (1,000/Reel)	
		ER	① = C～F USP-6C (3,000/Reel)	
		ER-G	① = C～F USP-6C (3,000/Reel)	

(*) The “-G” suffix denotes halogen and antimony free, as well as being fully ROHS compliant.

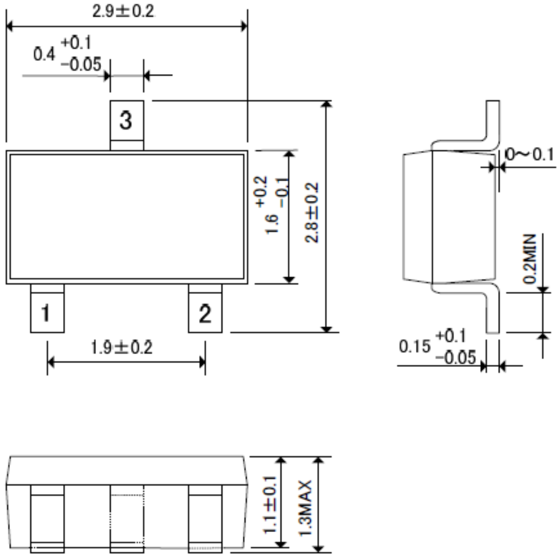
PRODUCT CLASSIFICATION



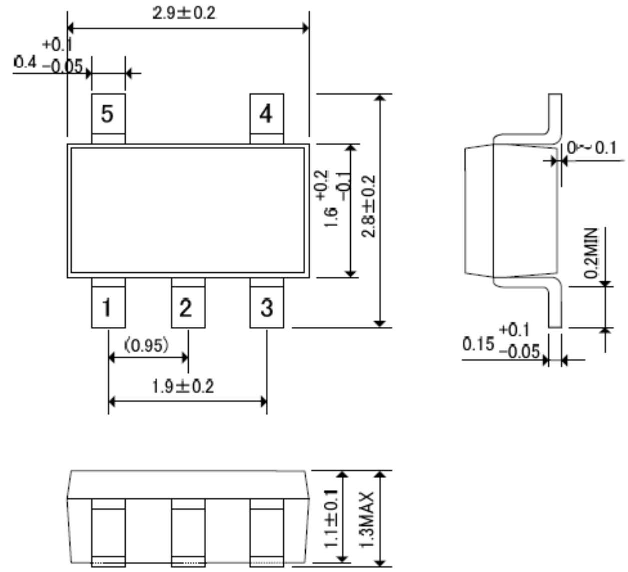
PACKAGE DRAWING AND DIMENSIONS

Units: mm

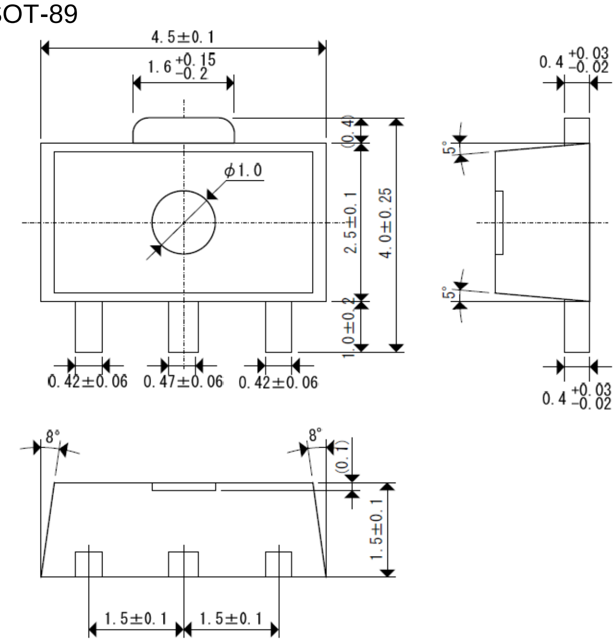
SOT-23



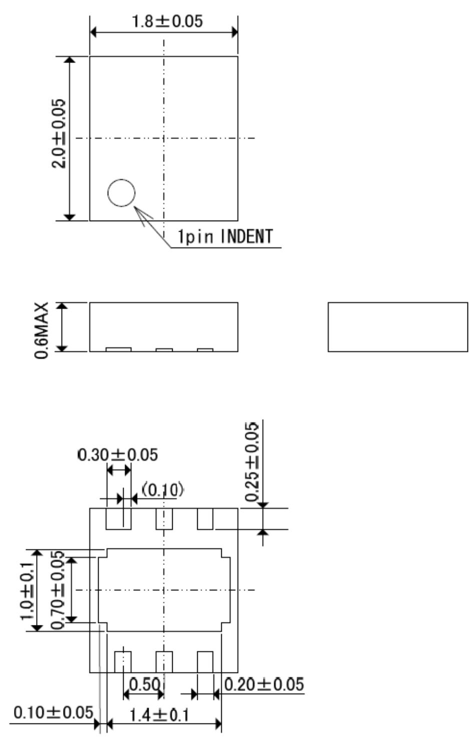
SOT- 25



SOT-89

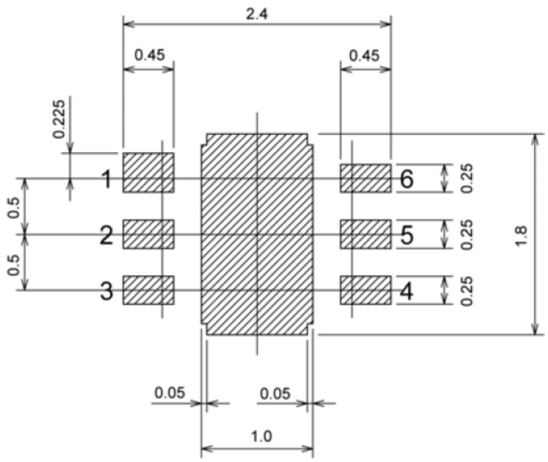


USP-6C

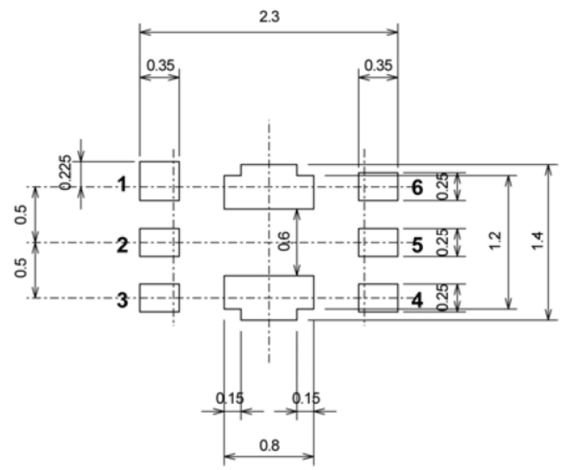


PACKAGE DRAWING AND DIMENSIONS

USP-6C Reference Pattern Layout

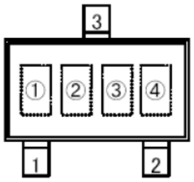


USP-6C Reference Metal Mask Design



MARKING

SOT-23



SOT-23 (TOP VIEW)

① represents product series

MARK	FUNCTION	PRODUCT SERIES
5	Built-In Transistor	IXD2111Axxxxx
6	External Transistor	IXD2111Bxxxxx

② represents integer of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
1.x	1
2.x	2
3.x	3
4.x	4
5.x	5
6.x	6
7.x	7

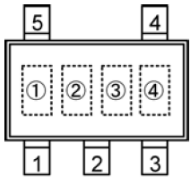
③ represents decimal point of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
x.0	0
x.1	1
x.2	2
x.3	3
x.4	4
x.5	5
x.6	6
x.7	7
x.9	8
x.9	9

④ represents production lot number 0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

MARKING (Continue)

SOT-25



SOT-25 (TOP VIEW)

① represents product series

MARK	FUNCTION		PRODUCT SERIES
V	CE	Built-in Transistor	IXD2110Cxxxxx
X	CE	External Transistor	IXD2110Dxxxxx
Y	V_{DD}/V_{OUT}	Built-in Transistor	IXD2110Exxxxx
Z	V_{DD}/V_{OUT}	External Transistor	IXD2110Fxxxxx
5	CE	Built-in Transistor	IXD2110Cxxxxx
6	CE	External Transistor	IXD2110Dxxxxx
7	V_{DD}/V_{OUT}	Built-in Transistor	IXD2110Exxxxx
8	V_{DD}/V_{OUT}	External Transistor	IXD2110Fxxxxx

② represents integer of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
1.x	1
2.x	2
3.x	3
4.x	4
5.x	5
6.x	6
7.x	7

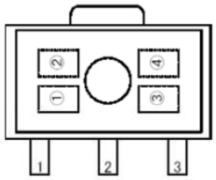
③ represents decimal point of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
x.0	0
x.1	1
x.2	2
x.3	3
x.4	4
x.5	5
x.6	6
x.7	7
x.9	8
x.9	9

④ represents production lot number 0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

MARKING (Continue)

SOT-89



① represents product series

MARK	FUNCTIONS	PRODUCT SERIES
5	Built-In Transistor	IXD2111Axxxxx
6	External Transistor	IXD2111Bxxxxx

② represents integer of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
1.x	1
2.x	2
3.x	3
4.x	4
5.x	5
6.x	6
7.x	7

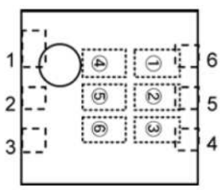
③ represents decimal point of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
x.0	0
x.1	1
x.2	2
x.3	3
x.4	4
x.5	5
x.6	6
x.7	7
x.9	8
x.9	9

④ represents production lot number 0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

MARKING (Continue)

USP-6C



USP-6C (TOP VIEW)

① represents product series

MARK	PRODUCT SERIES
M	IXD2110xxx1D
N	IXD2111xxx1D

② represents series type

MARK	FUNCTION		PRODUCT SERIES
C	CE	Built-in Transistor	IXD2110Cxxxxx
D	CE	External Transistor	IXD2110Dxxxxx
E	V_{DD}/V_{OUT}	Built-in Transistor	IXD2110Exxxxx
F	V_{DD}/V_{OUT}	External Transistor	IXD2110Fxxxxx

③ represents integer of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
1.x	1
2.x	2
3.x	3
4.x	4
5.x	5
6.x	6
7.x	7

④ represents decimal point of output voltage and oscillation frequency

OUTPUT VOLTAGE	MARK
	f_{OSC} = 100 kHz
x.0	0
x.1	1
x.2	2
x.3	3
x.4	4
x.5	5
x.6	6
x.7	7
x.9	8
x.9	9

⑤ represents oscillation frequency

MARK	OSCILLATION FREQUENCY	PRODUCT SERIES
1	100 kHz	IXD2111xx1Dx

⑥ represents production lot number 0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

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