

6 Functions 6 Digit Alarm- Chronograph Duplexed LCD Watch Circuit with EL Lamp Driver

July 1999 - revised November 2000

Features

- Single chip CMOS construction
- Drives 6 digit duplexes LCD with 7 day mark, AM/PM mark, date mark and alarm mark
- Colon display
- 32,768 Hz Crystal frequency
- On-chip oscillator and resistors
- On-chip voltage doubler
- Low power dissipation
- Debounce circuitry on switch inputs
- Protection against static discharge
- Trimmer capacitor included
- Economical solution for EL display
- No external component needed for delay function
- Min external components in application

Functions

Watch

- 6 Function: Month, Date, Day-of-Week, Hour, Minute, Second
- Alarm function with 4 to 5 minute snooze
- 6 Digit chronograph: Autoranging after 30 minutes to hour, minute, second
- User selectable 12 hour/24 hour format
- Alarm output for melody IC (KS5310, KS5381, KS5318 series)
- 4 Year calendar
- One touch correction of time error within ± 30 seconds
- Fast advance for time and alarm time set
- Chime on every hour

EL Lamp Driver

- Single 1.5 V or 3.0 V battery operation (mask option) (7089-01: -1.5 V, 7089-02: -3.0 V)
- DC to AC conversion
- Built-in delay function
- Two independent trigger inputs:
TRG (is active at high) makes EL display for 2,4 or 8 second delay (mask option),
BL (is active at high) makes EL flash without any delay (See Timing Diagram)
- Output frequency-32KHz, 16KHz, 8KHz, 4KHz or 2KHz (mask option)
- PMP duty circle 1/2, 3/4 or 7/8 (mask option)
- EL frequency – 1KHz, 512 Hz or 256 Hz (mask option)

Pin Description

N	Pad Name	I/O	Description	N	Pad Name	I/O	Description
1	F2/E2	O	Signal to LCD (Segment)	27	A6/SA	O	Signal to LCD (Segment)
2	G2/D2	O	Signal to LCD (Segment)	28	A5/FR	O	Signal to LCD (Segment)
3	B2/C2	O	Signal to LCD (Segment)	29	A4/TH	O	Signal to LCD (Segment)
4	F3/E3	O	Signal to LCD (Segment)	30	A3/WE	O	Signal to LCD (Segment)
5	G3/D3	O	Signal to LCD (Segment)	31	COL/TU	O	Signal to LCD (Segment)
6	B3/C3	O	Signal to LCD (Segment)	32	A2/MO	O	Signal to LCD (Segment)
7	F4/E4	O	Signal to LCD (Segment)	33	C1/B1	O	Signal to LCD (Segment)
8	G4/D4	O	Signal to LCD (Segment)	34	ADEG/SU	O	Signal to LCD (Segment)
9	B4/C4	O	Signal to LCD (Segment)	35	PM/AM	O	Signal to LCD (Segment)
10	F5/E5	O	Signal to LCD (Segment)	36	COM2	O	Signal to LCD (Common)
11	G5/D5	O	Signal to LCD (Segment)	37	M	I	Switch M
12	B5/C5	O	Signal to LCD (Segment)	38	AC	I	Common reset
13	F6/E6	O	Signal to LCD (Segment)	39	TRG	I	Signal EL display (Pull down)
14	G6/D6	O	Signal to LCD (Segment)	40	BL	I	Signal EL flash (Pull down)
15	B6/C6	O	Signal to LCD (Segment)	41	V _{DD}		Positive Power Supply
16	T1	I	Test Pad1	42	DCHG	O	DC-AC converter
17	V _{DD}		Positive Power Supply	43	V _{EE2}		Negative Power Supply for EL Driver
18	T2	I	Test Pad2	44	PMP	O	DC-AC converter
19	V _{EE1}		Voltage Doubler Supply	45	V _{SS}		Negative Power Supply
20	1KO	O	Voltage Doubler Capacitor	46	ALB	O	Sound Converter
21	CAP	I	Voltage Doubler Capacitor	47	ALA 2	O	Sound Converter (Open drain output)
22	S	I	Switch S	48	ALA1	O	Sound Converter
23	D	I	Switch D	49	OO	O	Oscillator output
24	T3	I	Test Pad 3	50	OI	I	Oscillator input
25	COM1	O	Signal to LCD (Common)				
26	DATE/AL	O	Signal to LCD (Segment)				

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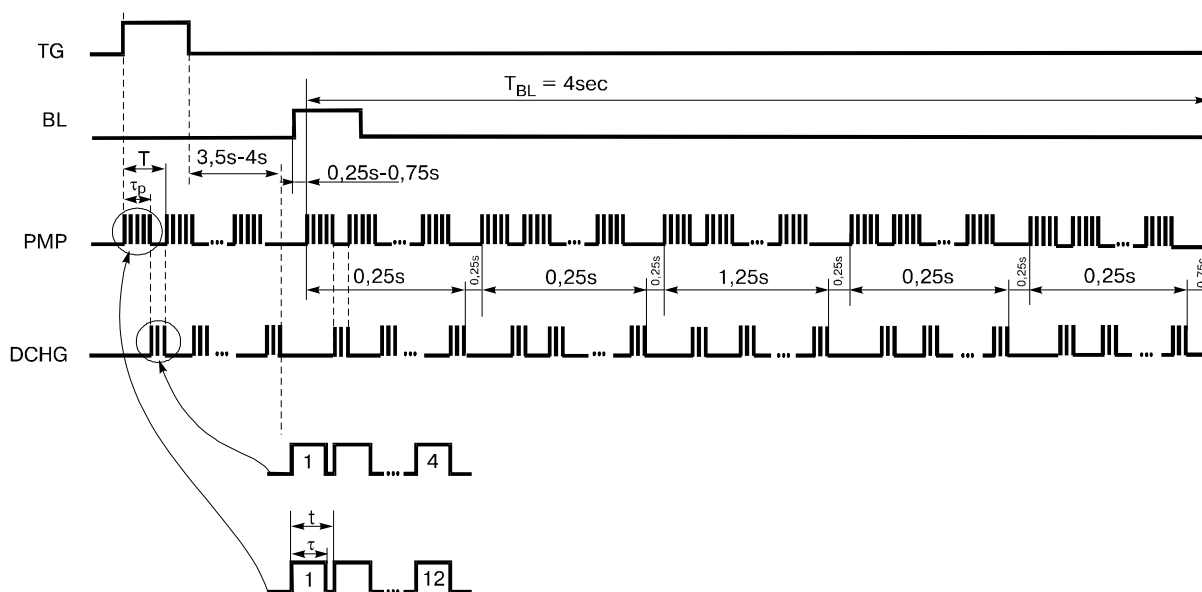
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Option List

Option	V_{EE2} (V)	Output		PMP		PMP Output Source Current I_{OH1} (mA)			Delay (sec)
		Frequency, f_0 (KHz)	Duty Circle	Frequency F (Hz)	Duty Circle	Min	Typ	Max	
MIK7089F-01	-1.5	16	3/4	512	3/4		-1.2	-0.7	4
MIK7089F-02	-3.0	16	3/4	512	3/4		-1.2	-0.7	4

Timing Diagram

(for MIK7089F-01, 02)



$$f_0 = 1/t = 16 \text{ KHz}, \tau = 3/4 \cdot t$$

$$F = 1/T = 512 \text{ Hz}, \tau_p = S \cdot T$$

EL flash continuously as period $T_{BL} = 4\text{s}$ at BL is low level invariably.

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Electrical Characteristics MIK7089F-01

(T_a = 25°C, V_{DD} = 0 V, V_{SS} = V_{EE2} = -1.5 V; unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Operating Voltage	V _{SS} = V _{EE2}		1.2	1.5	1.8	V
	V _{EE1}		2.4	3.0	3.6	V
Supply Current	I _{DD}	Without Load			2.0	μA
Input High Voltage	V _{IH}		-0.3		0	V
Input Low Voltage	V _{IL}		V _{SS}		V _{SS} +0.3	
Oscillator Start Voltage	V _{OSC}	Within 5 sec			1.45	V
Oscillator Frequency	F _{OSC}			32.768		KHz
DC-DC Conversion Frequency	F _{CON}	C ₁ = C ₂ = 0.1 μF		1.024		KHz
LCD Frequency	F _d			32		Hz
Time Stability	T _{stb}	V _{SS} = -1.2 ~ -1.8 V			3	ppm
Switch Debouncing Time	T _{deb}				31.25	msec
Output drive Current	I _{OH}	PMP, V _{OH} = -0.7V DCHG, V _{OH} = -0.7V	-1.7		-0.7 -0.2	mA
Output sink Current	I _{OL}	PMP, V _{OL} = -0.9V DCHG, V _{OL} = -0.9V	15 1			mA
Alarm Driver Current	I _{OL}	ALA2, V _{OL} = -0.4V	50			mA
	I _{OH}	ALA1, V _{OH} = -0.7V, V _{SS} = -1.4V			-1.5	mA
	I _{OL}	ALA1, V _{OL} = -0.7V, V _{SS} = -1.4V	1.5			mA
	I _{OL}	ALB, V _{OL} = -0.7V, V _{SS} = -1.4V	20			μA

Quartz Crystal Parameters: F_p = 32768 Hz, C_L = 12.5pF, C₀ = 1.2pF, C₁ = 3.0pF, R_r = 35KΩ

Electrical Characteristics MIK7089F-02

(T_a = 25°C, V_{DD} = 0 V, V_{SS} = -1.5 V, V_{EE2} = -3.0 V; unless otherwise specified)

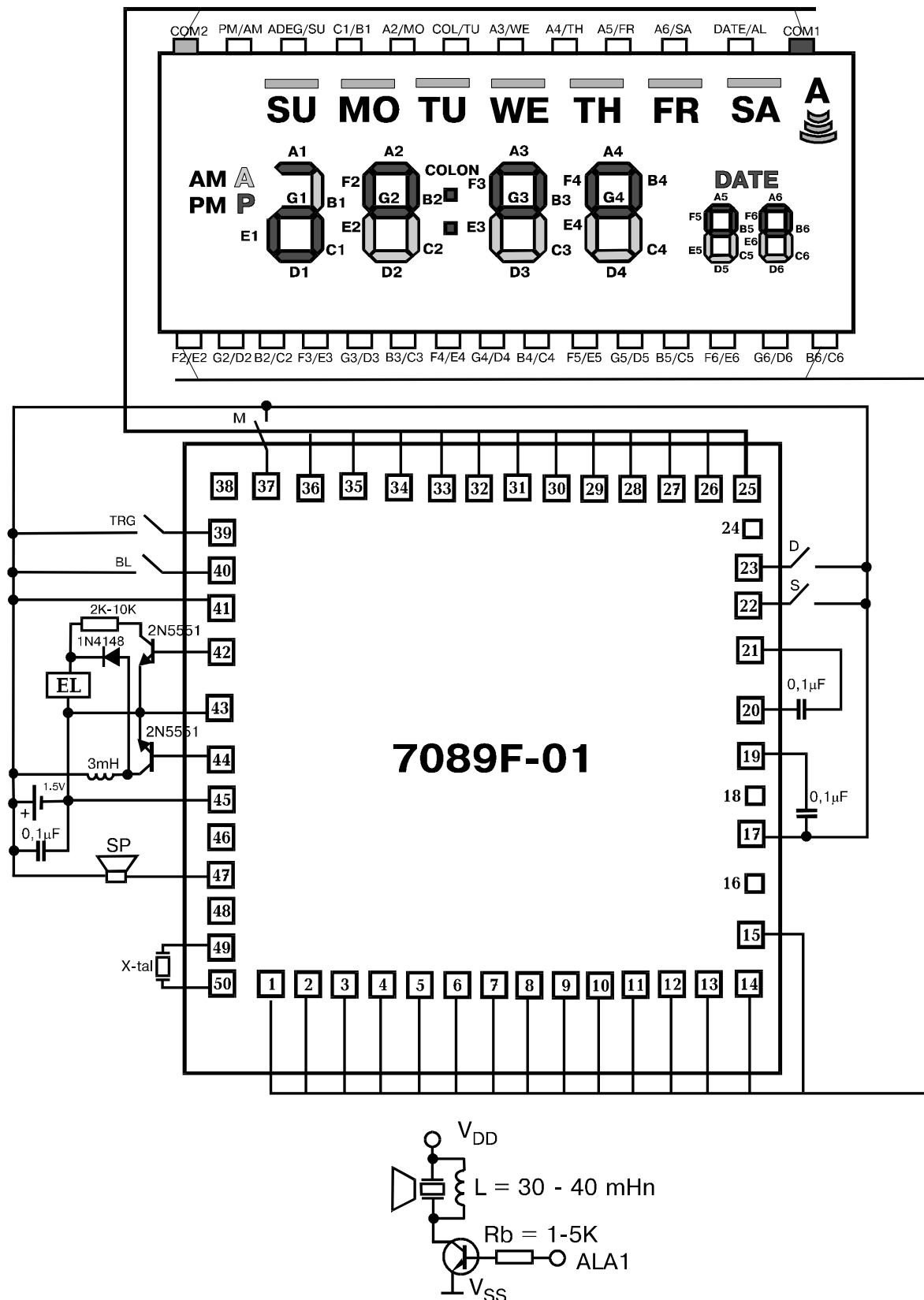
Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
Operating Voltage	V _{SS}		1.2	1.5	1.8	
	V _{EE1}		2.4	3.0	3.6	V
	V _{EE2}		1.2	3.0	3.6	
Supply Current	I _{DD}	Without Load			2.0	μA
Input High Voltage	V _{IH}		-0.3		0	V
Input Low Voltage	V _{IL}		V _{SS}		V _{SS} +0.3	
Oscillator Start Voltage	V _{OSC}	Within 5 sec			1.45	V
Oscillator Frequency	F _{OSC}			32.768		KHz
DC-DC Conversion Frequency	F _{CON}	C ₁ = C ₂ = 0.1 μF		1.024		KHz
LCD Frequency	F _d			32		Hz
Time Stability	T _{stb}	V _{SS} = -1.2 ~ -1.8 V			3	ppm
Switch Debouncing Time	T _{deb}				31.25	msec
Output drive Current	I _{OH}	PMP, V _{OH} = -2.2V DCHG, V _{OH} = -2.2V	-3.4		-1.4 -0.2	mA
Output sink Current	I _{OL}	PMP, V _{OL} = -2.4V DCHG, V _{OL} = -2.4V	15 1			mA
Alarm Driver Current	I _{OL}	ALA2, V _{OL} = -0.4V	50			mA
	I _{OH}	ALA1, V _{OH} = -0.7V, V _{SS} = -1.4V			-1.5	mA
	I _{OL}	ALA1, V _{OL} = -0.7V, V _{SS} = -1.4V	1.5			mA
	I _{OL}	ALB, V _{OL} = -0.7V, V _{SS} = -1.4V	20			μA

Quartz Crystal Parameters: F_p = 32768 Hz, C_L = 12.5pF, C₀ = 1.2pF, C₁ = 3.0pF, R_r = 35KΩ

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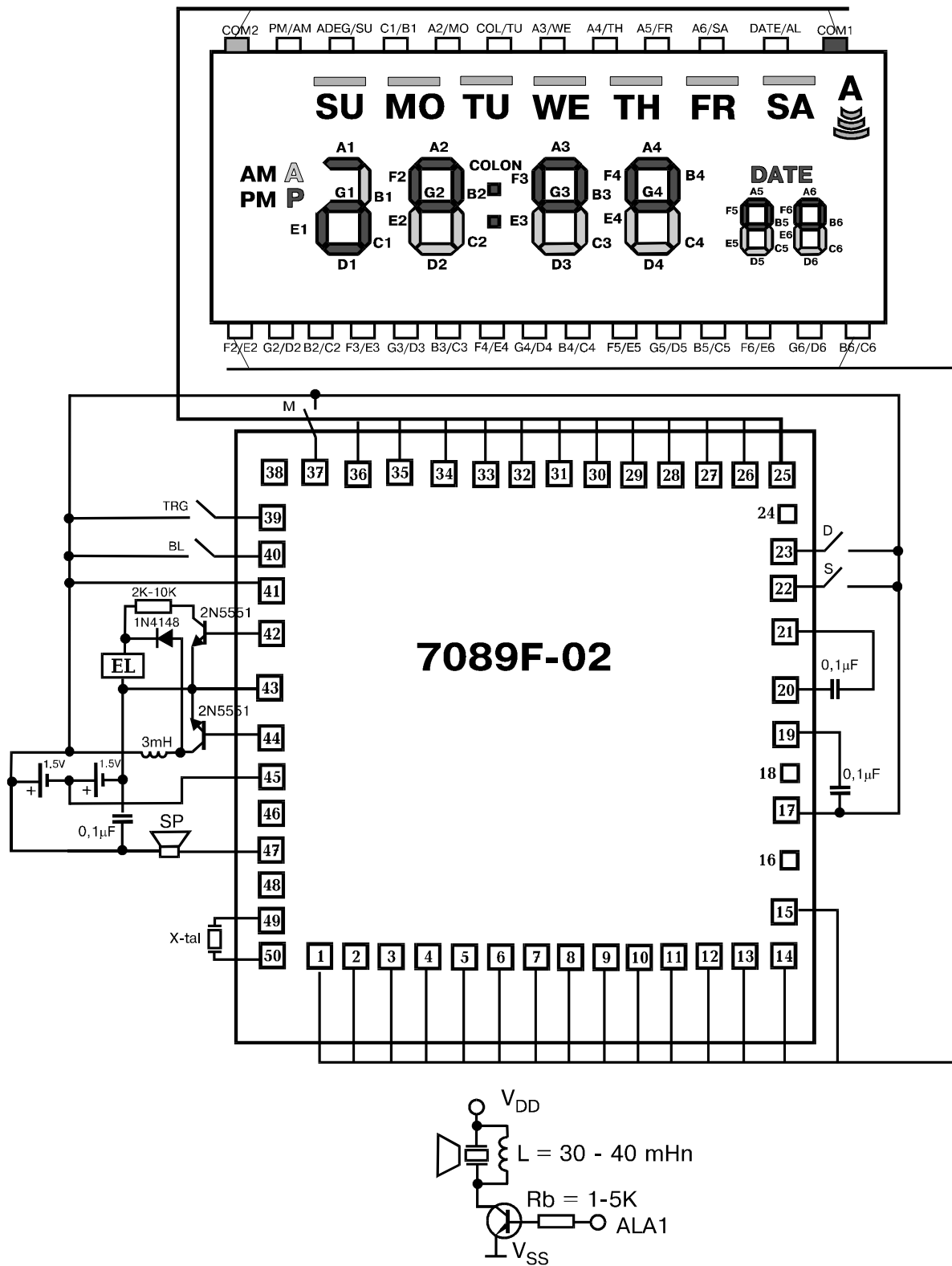
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Application Circuit



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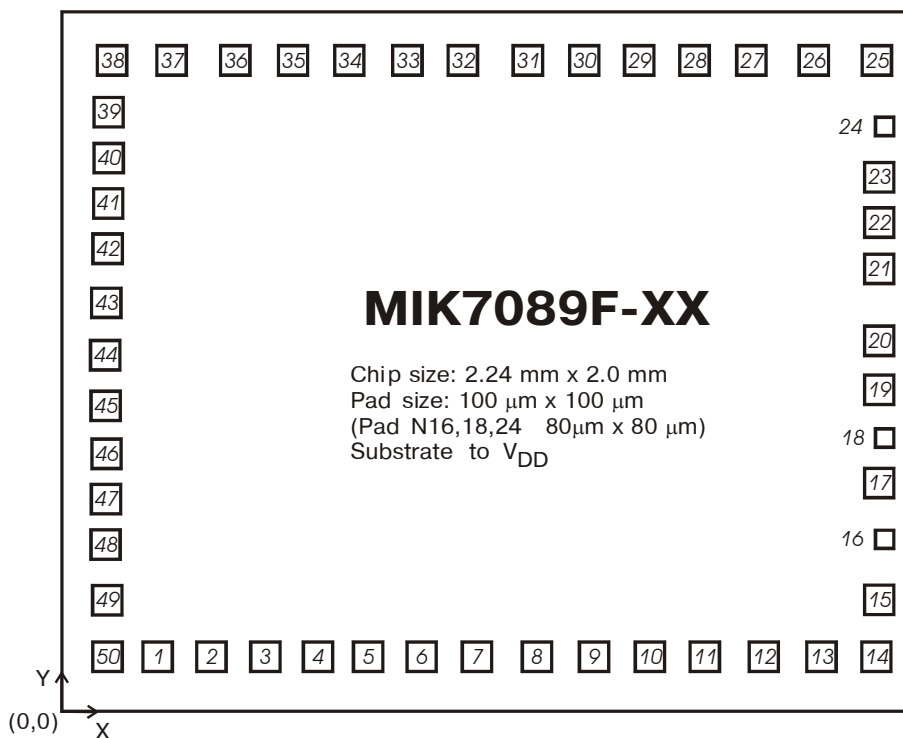
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Pad location



Pad	Pad name	X	Y	Pad	Pad name	X	Y	Pad	Pad name	X	Y
1	F2/E2	277	135	19	V_{EE1}	2102	951	37	M	372	1865
2	G2/D2	417	135	20	1KO	2102	1115	38	AC	137.5	1865
3	B2/C2	557	135	21	CAP	2102	1286	39	TG	137.5	1725
4	F3/E3	697	135	22	S	2102	1458	40	BL	137.5	1585
5	G3/D3	837	135	23	D	2102	1598	41	V_{DD}	137.5	1445
6	B3/C3	977	135	24	T3	2112	1745	42	DCHG	137.5	1305
7	F4/E4	1117	135	25	COM1	2102	1865	43	V_{EE2}	137.5	1165
8	G4/D4	1257	135	26	DATE/AL	1940	1865	44	PMP	137.5	1025
9	B4/C4	1397	135	27	A6/SA	1800	1865	45	V_{SS}	137.5	885
10	F5/E5	1537	135	28	A5/FR	1660	1865	46	ALB	137.5	723
11	G5/D5	1677	135	29	A4/TH	1520	1865	47	ALA2	137.5	583
12	B5/C5	1817	135	30	A3/WE	1380	1865	48	ALA1	137.5	448
13	F6/E6	1952	135	31	COL/TU	1240	1865	49	OO	137.5	292
14	G6/D6	2102	135	32	A2/MO	1100	1865	50	OI	137.5	135
15	B6/C6	2102	286	33	C1/B1	960	1865				
16	T1	2112	500	34	ADEG/SU	820	1865				
17	V_{DD}	2102	665	35	PM/AM	680	1865				
18	T2	2112	806	36	COM2	517	1865				