Clare micronix
INTEGRATED SYSTEMS, INC.
An IXYS Company

MXED203

160-Channel OLED Row Driver

FEATURES:

- For all Passive-Matrix Organic Light Emitting Diode (OLED) Displays
- Monochome and Color
- Small Molecule and Polymer
- Common-Cathode Row Switching
- CMOS High Voltage Process: 5V-30V Display Panel Supply Compatible
- 160 Output Channels, Cascadable; Configurable 144-Output Mode
- 150mA Maximum Current Capability per Channel (two channels maximum active simultaneously)
- 20 Ohm Maximum Row Switch "On" Resistance
- Token-Based Control; Bidirectional data transfer; Single- and Dual-Token Modes
- 3V to 5.5V logic supply
- Up to 100 kHz Clock Frequency
- Gold-Bumped Die @ 60 micron Output Pitch
- TCP Package Option
- Compatible with **Clare Micronix** 100 Series OLED Column Drivers

OVERVIEW:

Clare Micronix's MXED203 is a row-multiplexed display driver for OLED panel displays. The MXED203 directly supports up to 160-row OLED panel displays, or can be cascaded for controlling additional rows. The MXED203's low "on" switch resistance ensures uniform luminance at rapid row scan rates. The MXED203 is the second generation device in Clare's family of row drivers for OLED displays.

FUNCTIONAL DESCRIPTION

The MXED203 is capable of sinking current for up to 160 rows (LED cathodes) of an OLED display. One or two outputs may be active at a time. For displays requiring more than 150mA sink current per row, multiple MXED203's may be placed in parallel.

Device settings, such as token direction, number of active rows, dual or single-token mode, and others, are set by dedicated input pins.

Figure 1 is a block diagram of the MXED203. Each row output has two possible sources: ground, to turn the LED on, and VOH (Voltage Output High) to turn the LED off. To begin a scan of the rows, the user inputs a token bit so that it is high at the rising edge of CLK, which is typically provided by the MXED102 or similar column driver or controller. In "normal mode" (single token), the token may be entered at either end of the MXED203 row shift register (SRIN or SLIN), depending on the shift direction selection control "Shift Right" (SHR). The token bit is shifted one row (one channel) per clock cycle (CLK), during which time only one row maximum is active at a time. In "dual mode" (DUAL), the token bit is entered at one end and automatically in the center, and again the token bits may be selectively shifted left or right at the CLK rate; during which time only two rows maximum are active at a time. The MXED203 may be used for either 160- or 144-row display panels. When the "Select 160" (S160)

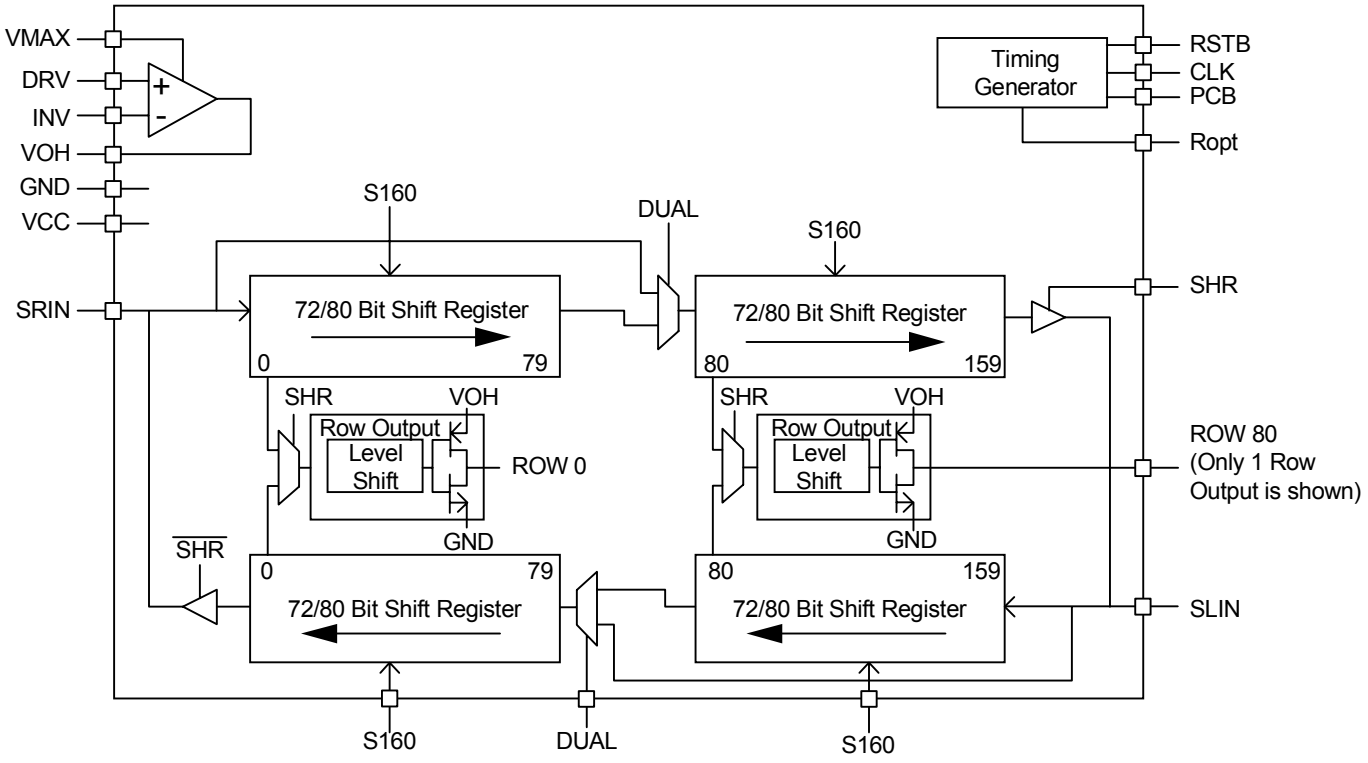
FUNCTIONAL DESCRIPTION - continued

control input is low, the MXED203 is set for 144 outputs. When S160 is low, Rows 8 through 151 must be used. (Note: A lesser number of rows may be used by resetting the MXED202 (RSTB) at any time, truncating the shift cycle.) Please refer to the table of Token Shift Options.

The MXED203 fully supports column precharge of OLED display panels. During column precharge the active row output will be high (VOH) from the time CLK occurs until PCB (typically provided by the column driver) goes high. When PCB goes high, indicating that precharge is completed, the active row output will go low, allowing the diode to turn on. All inactive row outputs will remain high.

The "off" output voltage, VOH, is connected to the output of an internal op-amp. This op-amp may be used to generate VOH, or it may be bypassed. If it is bypassed, VOH is tied directly to VMAX, as are inputs VDRV and INV. If the op-amp is to be used to generate VOH, VDRV is used as the non-inverting op-amp input, and INV is used as the inverting op-amp input. External resistors are used to set the gain, and thus VOH. Figure 4 shows the circuit options for generating VOH.

FIGURE 1 - MXED203 BLOCK DIAGRAM



MXED203 DATA SHEET

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TABLE 1 - TOKEN SHIFT OPTIONS

	DUAL - SHR				
S160	**00**	**01**	**10**	**11**	**Outputs Used**
	Token	Input	Position		
0	151	8	151,79	8,80	144-Row Mode uses rows 8-151 (rows 0-7, 152-159 N/C)
1	159	0	159,79	0,80	160-Row Mode uses rows 0-159

INPUT/OUTPUT PAD DESCRIPTIONS

Name	I/O/A	Description
RTN	I	Return for all display current. Connect to low impedance ground.
GND	I	Ground, the negative return for all chip current and the digital logic "zero" reference level.
VCC	I	The logic voltage positive supply. MXED202 logic operates between VCC and VSS.
VMAX	I	This voltage maximum is the highest positive power supply voltage present on the chip. Inputs to the chip should not exceed VMAX to avoid forward biasing internal substrate diodes.
VOH	I/O/A	Row Voltage Output High supply. This pin is normally connected to an external power supply pin VMAX with bypass capacitor (typically 4.7uF), and to pin DRV. Alternatively, an internal amplifier can generate VOH from an input voltage DRV.
INV	I	Inverting input to Voltage Regulator Op Amp, to which an input Resistor RI and feedback Resistor RF may be connected to develop VOH from VDRV; see DRV pin. See Figure 4.
DRV	I	Non-inverting input to the Voltage Regulator Op Amp.
SHR	I	Active high static Shift Right control input: When SHR=0, the token bit travels from R159 to R0, with SLIN being the token input, SRIN the token output. SHR should always be driven to the desired logic level. Configuration pin.

I = INPUT, O = OUTPUT, A = ANALOG

INPUT/OUTPUT PAD DESCRIPTIONS (continued)

Name	I/O/A	Description
SRIN	I/O	Shift Right Input. This bi-directional pin is the token input when SHR is high, and the token output (for synchronization or cascading) when SHR is low. When configured as an input, this pin should always be driven. Normally low, SRIN should be driven high once per frame to enter the token into the shift register.
SLIN	I/O	Shift Left Input. This bi-directional pin is the token input when SHR is low, and the token output (for synchronization or cascading) when SHR is high. When configured as an input, this pin should always be driven. Normally low, SLIN should be driven high once per frame to enter the token into the shift register.
SLPB	I	When low puts the device into a low-power standby mode. Connect to VCC (logic high) for normal operation.
DUAL	I	DUAL tokens are seeded into the first and middle shift register cells from SRIN or SLIN when DUAL is static active high. When low, a single token is active. Configuration pin.
CLK	I	The rising edge of the CLK input shifts the token along the internal shift register to activate successive rows.
PCB	I	If the PreCharge Bar input is low on the rising edge of CLK, all row outputs will be switched to VOH to enable display panel column precharging until PCB returns high. Holding PCB high disables column precharge.
S160	I	Select 160 row driver output mode when static active high. When low, 144 row driver output mode is selected. Configuration pin.
ROPT	I/O/A	Resistor OPTion pin, normally N/C for digitally controlled precharge timing (PCB), or when precharge is disabled. When a resistor R is connected between ROPT and PCB, and a capacitor C is connected between PCB and VSS, the precharge time will be RC/1.65 when measured from the rising edge of CLK to the falling edge of ROPT. The timing components should be selected such that RC/1.65 not exceed 10 of the row active time.
RSTB	I	Reset Bar - active low reset input, clears all the shift register cells, eliminating token content.
R(n)	O	Row driver outputs. R(0)-R(159) are used in 160 output mode, S128=1. Only R(8)-R(151) should be connected when S160=0.
HREF	O	High voltage REFerence is an internally generated PFET switch drive voltage (approximately VOH-5V), which should be bypassed to VOH with a 2200pF external capacitor.
LREF	O	Low voltage REFerence is an internally generated NFET switch drive voltage (approximately 5V), which should be bypassed to GND with a 2200pF external capacitor.

ELECTRICAL SPECIFICATION

Note: Positive currents flow into the part, negative currents flow out of the part.

Absolute Maximum Ratings:

Stresses beyond "Absolute Maximum Ratings" may cause damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may permanently affect device reliability.

Parameter	Sym	Min	Typ	Max	Units
Storage temp	T_A	-65		155	ºC
Low voltage supply	VCC	-0.3		7.0	V
High voltage supply	VMAX	-0.3		35.0	V

Note: Failure to apply both VCC & VMAX may cause damage to this device.

Operating Conditions: **Unless otherwise stated, all parameters are specified for the following operating conditions.**

Parameter	Sym	Operating Condition	Min	TYP	Max	Units
Ambient temp	T_A		0		70	ºC
Low voltage supply	VCC		3.0		5.5	V
High voltage supplies	VMAX		5.0		30	V
Clock Frequency	CLK				100	kHz

Chip Supply Currents – Exclusive of Load

Parameter	Sym	Operating Condition	Min	Typ	Max	Units
Logic Supply, Operating	I_{VCC}	SLPB=1;		140	210	µA
Logic Supply, Powerdown	I_{VCC}	SLPB=0;		15	100	µA
High Voltage Supply, Operating	I_{VMAX}	SLPB=0;		445	700	µA
High Voltage Supply, Powerdown	I_{VMAX}	SLPB=0;			75	µA

Digital Inputs: SHR, SRIN, SLIN, DUAL, CLK, PCB, MONO, S128, RSTB, MOD

Parameter	Sym	Operating Condition	Min	Typ	Max	Units
Input low voltage	V_{IL}		0		0.4	V
Input high voltage	V_{IH}		VCC-0.4		VCC	V
Input current	I_{IH}		-10		10	µA
Input current	I_{IL}		-10		10	µA
Clock Rise Time	CLKRT				25	nS
Clock Fall Time	CLKFT				25	nS
Clock Pulse Width	CLK		100			nS
Setup Time	TSet	Time in advance of 10 rising edge of CLK that inputs SRIN and SLIN must be valid to take effect on next clock cycle.	50			nS
Hold Time	THold	Time subsequent to 90 rising edge of CLK that inputs SRIN and SLIN must be valid to take effect on next rising edge of the clock (CLK).	10			nS

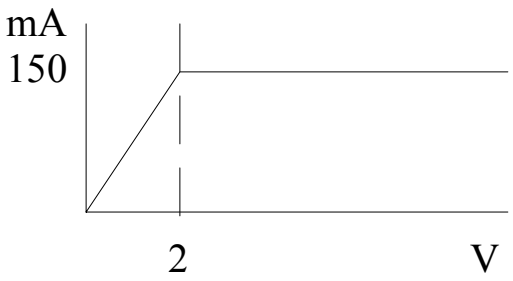
Digital Outputs: SRIN, SLIN, ROPT

Parameter	Sym	Operating Condition	Min	Typ	Max	Units
Output low voltage	VOL	Iout = 200 µA			0.4	V
Output high voltage	VOH	Iout = -200 µA	VCC-0.4			V
Output rise/fall time	TRF	10 to 90 , Cload = 5 pF			50	nS
Precharge Timing Resistor connected to pin ROPT	RROPT		50		200	kOhm

Analog Inputs: DRV, INV

Parameter	Sym	Operating Condition	Min	Typ	Max	Units
DRV Pin Input Resistance	DRVRin		10			kOhm
DRV Pin Input Capacitance	DRVCin				10	pF
Voltage Range of DRV Input	VDRV	VOH option C (Figure 4). Gain must be set to make VOH minimum of 5V.	1.0		VMAX-1.5	V
Feedback Resistor from VOH to INV	RF		10		100	kOhm
Input Resistor from INV to GND	RI		10		100	kOhm
Gain Ratio	G_R	G_R=1+Rf/Ri	1.1		11	-

FIGURE 2 - TYPICAL ROW OUTPUT CHARACTERISTICS



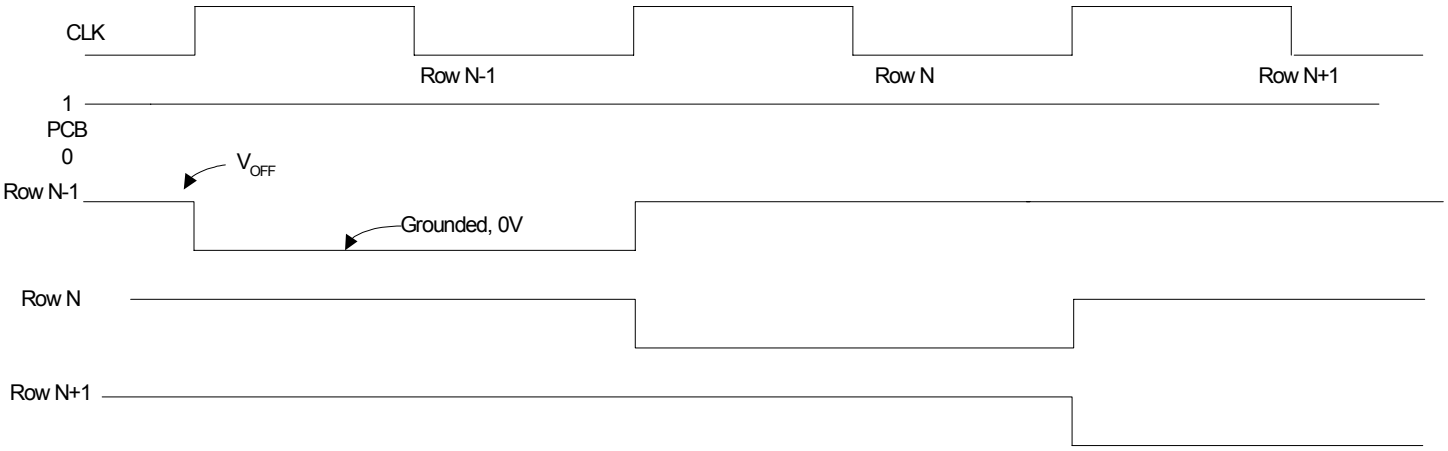
Analog Outputs: VOH, HREF, LREF, R(n)

Bypass capacitors to GND: C_{VOH}= 10µF; C_{HREF}, C_{LREF} = 2nF

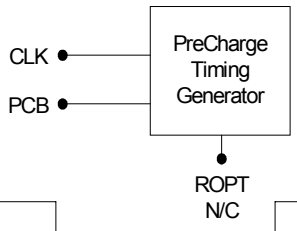
Parameter	Sym	Operating Condition	Min	Typ	Max	Units
Row Off Voltage	VOH	Iout avg= 100 µA, CLOAD=1000pF	5		30	V
Row Off Voltage Ripple	VOHac	Voltage Regulator Cload=0.02uF			100	mVp-p
VOH Current Output	I_{VOH}		50			mA
Row 0-159 Output Current Sink	I_{ROW}		150			mA
Row 0-159 Output Pulldown Resistance (to enable OLED turn-on)	RowON	VROW < 2V			20	Ohms
Row 0-159 Output Pullup Resistance (to disable OLED turn-on)	RowOFF	VROW > (VOH-2V)			300	Ohms
Row 0-159 Chip Output Capacitance	CRow	Per output			20	pF

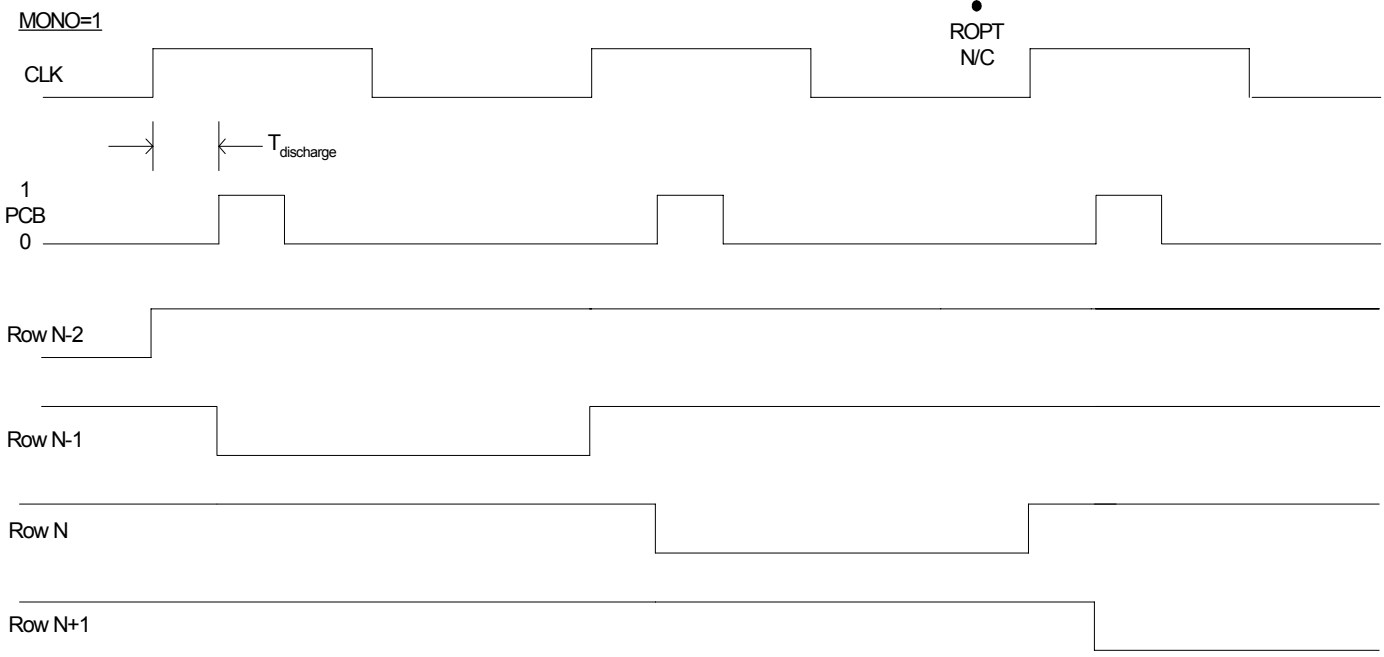
FIGURE 3 - TIMING DIAGRAMS

Row Output Timing with PCB=1

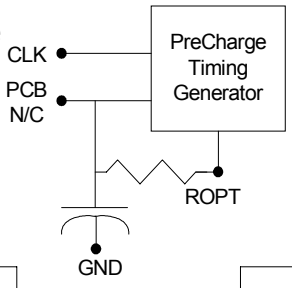


Row Output Timing With PCB Input Active. Column Precharge Time is from rising edge of CLK to rising edge of PCB





Row Output Timing Using RC Network. Precharge Time is from rising edge of CLK to 0.6 RC time constants



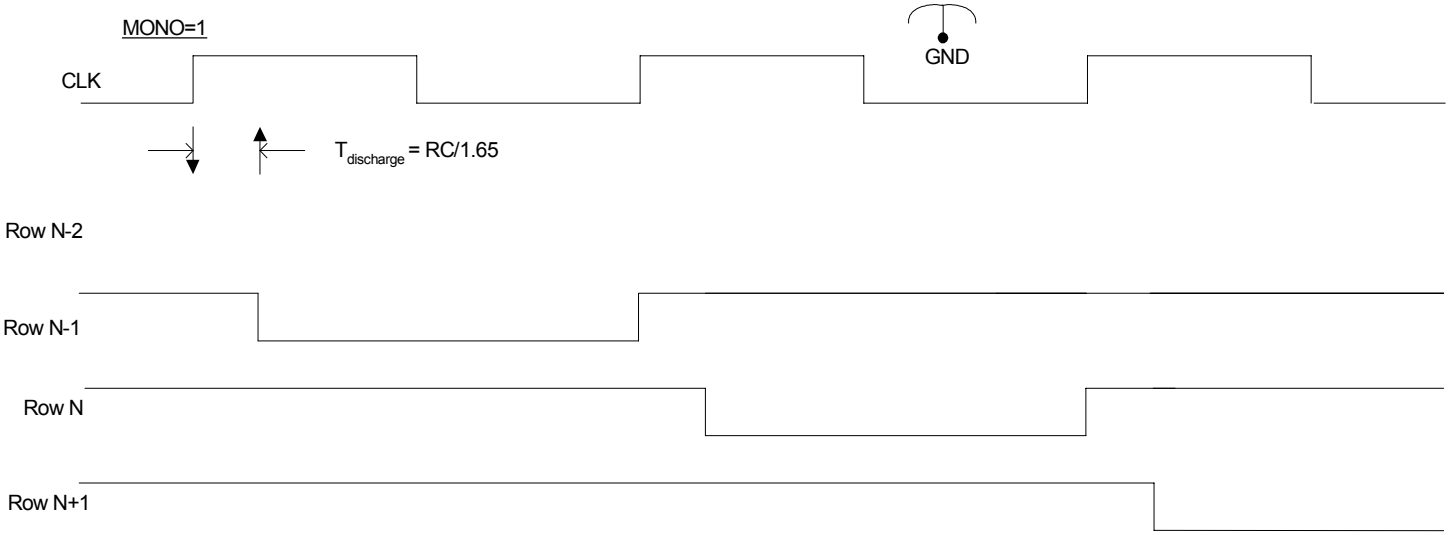


FIGURE 4 - VOH GENERATION OPTIONS

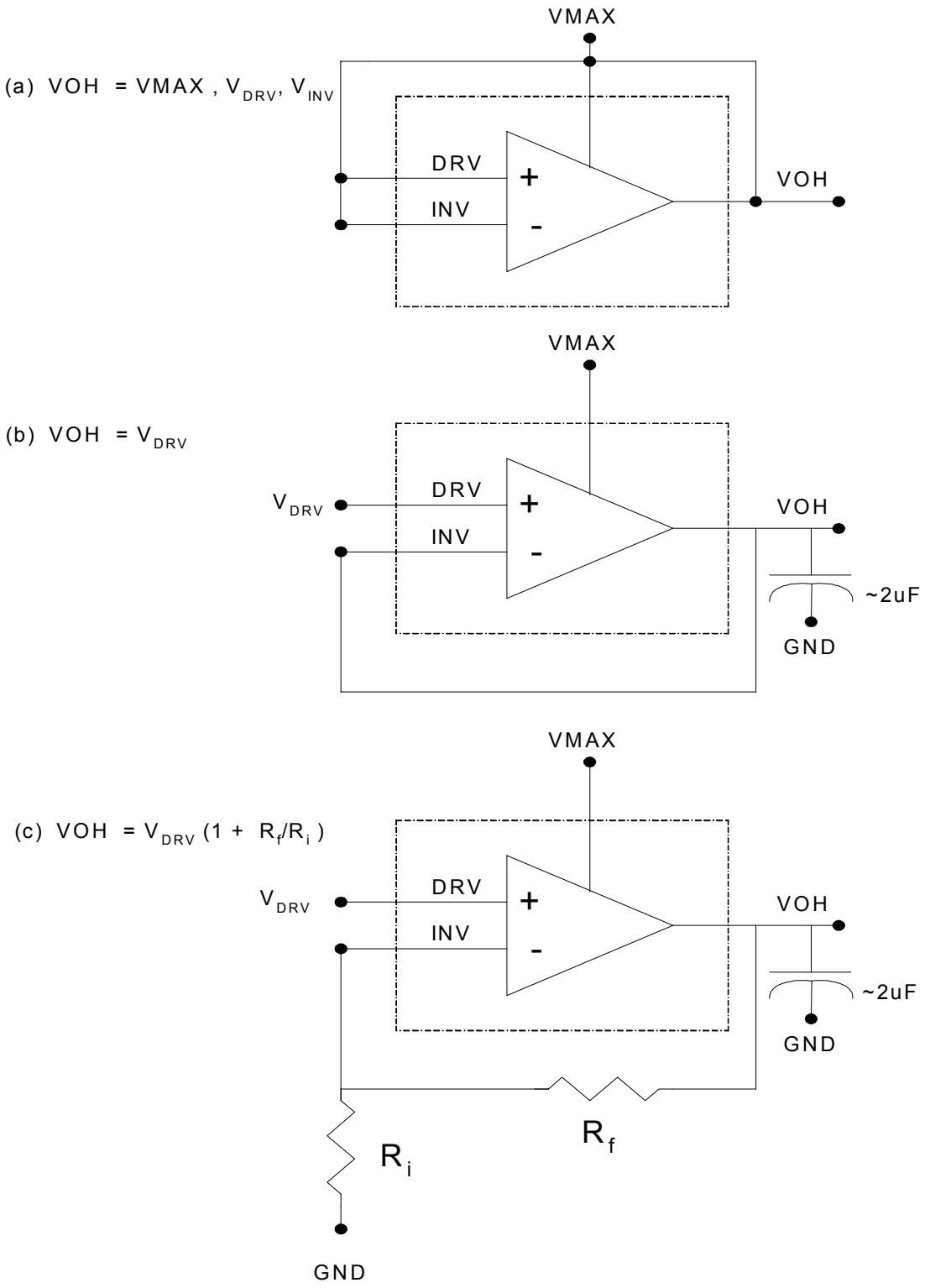
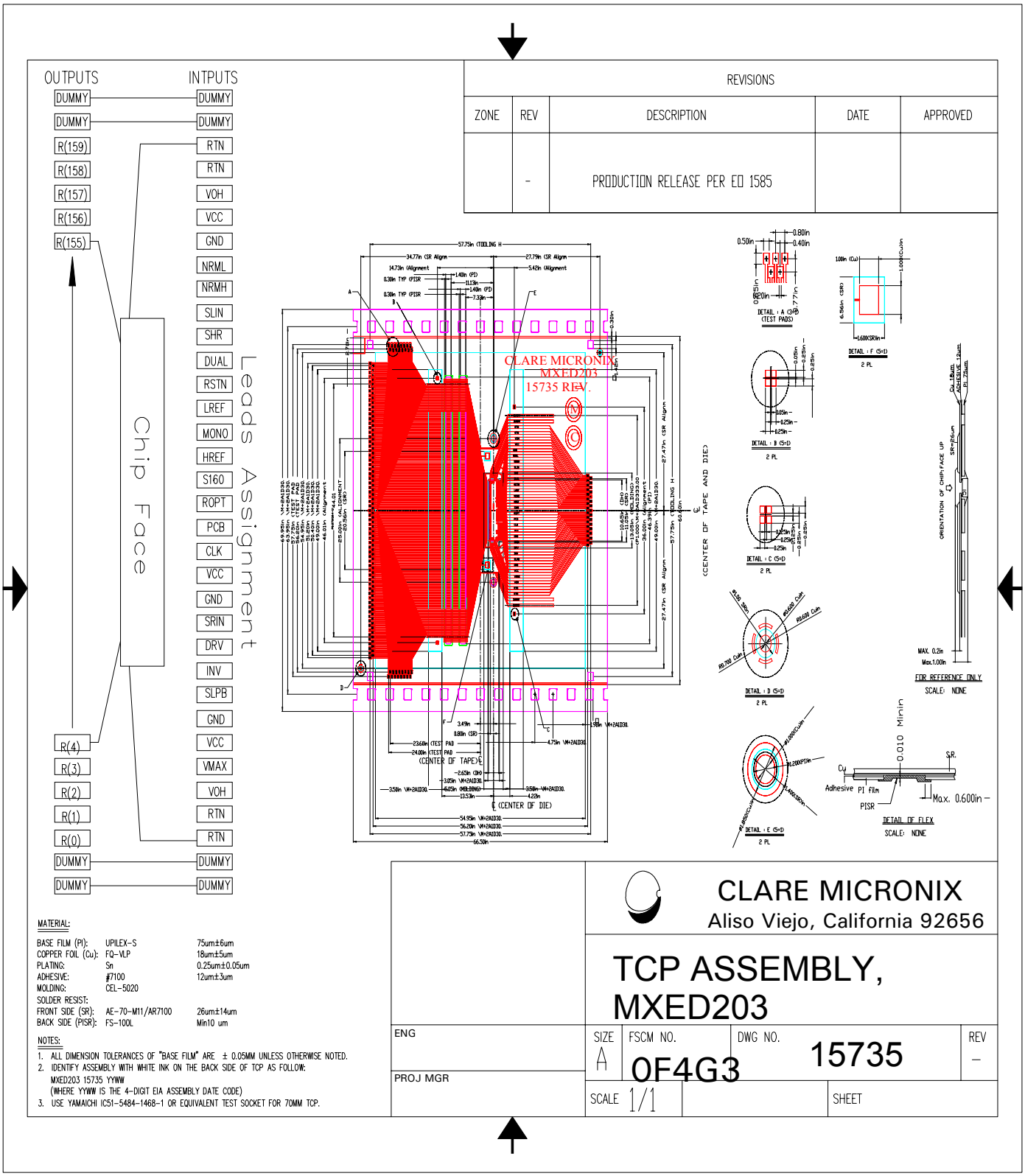


FIGURE 5 - TCP ASSEMBLY DRAWING



Note: The above TCP package drawing (Drawing Number 15735) is also available on the factory website @ www.claremicronix.com

MECHANICAL SPECIFICATIONS

DIE SPECIFICATIONS

Die Dimensions:		
"X" Dimension	10250 µm	Measured from center of scribe to center of scribe
"Y" Dimension	2250 µm	Measured from center of scribe to center of scribe
Thickness	600 µm (nominal)	Unthinned (non-back lapped wafer)
Gold Bump Height	15±3 µm	

Die Materials:	
Passivation	Silicon Nitride (SiN)
Gold Bump Hardness	45-75 HV
Wafer	Silicon (Si)

Note: The active surface is sensitive to light. Cover with an opaque material after assembly.

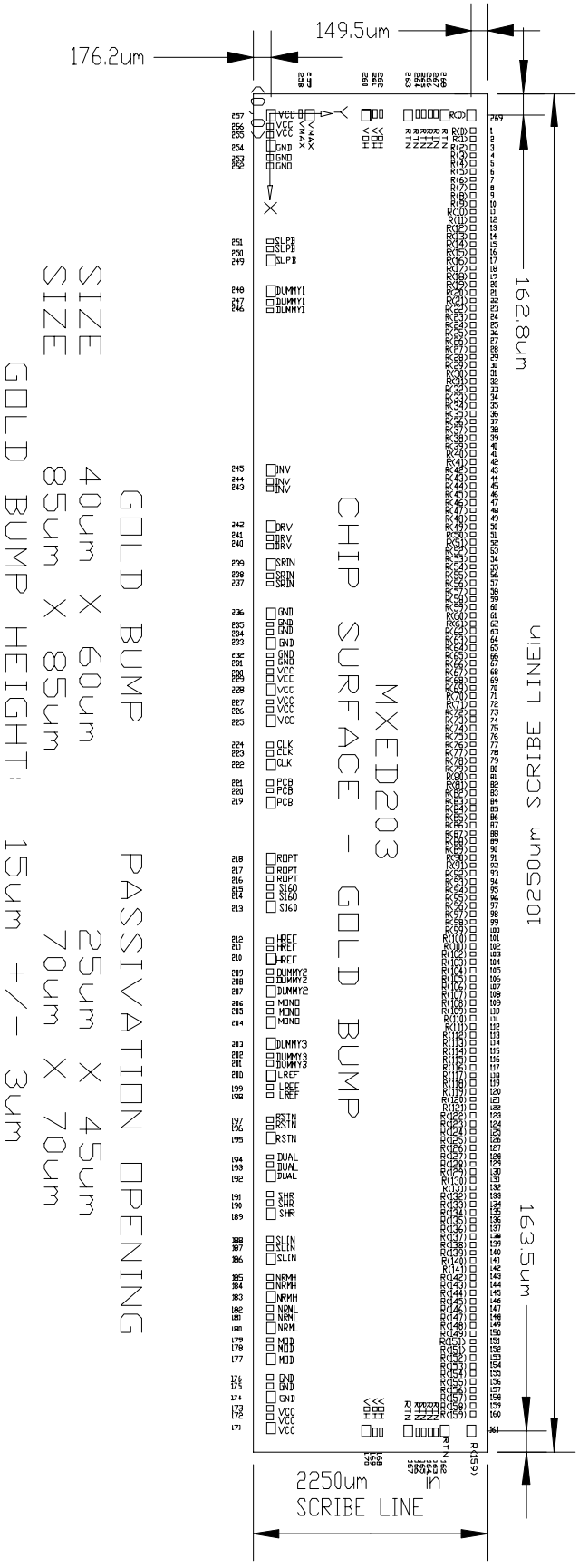
COORDINATES RELATIVE TO ORIGIN (0, 0) AT MINIMUM PAD LOWER LEFT LOCATION

Corners of Scribe Centers

Lower Left: X = -150.3µm, Y = -163.7µm

Upper Right: X = 10099.7µm, Y = 2086.3µm

FIGURE 6 - DIE DIMENSIONAL DRAWING



DIE PAD LOCATIONS REFERENCED TO ORIGIN - PADS LABELLED N/C MUST BE LEFT UNCONNECTED

NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
R(0)	1	.040 X .060	0.1305	1.9493
R(1)	2	.040 X .060	0.1914	1.9493
R(2)	3	.040 X .060	0.2523	1.9493
R(3)	4	.040 X .060	0.3132	1.9493
R(4)	5	.040 X .060	0.3741	1.9493
R(5)	6	.040 X .060	0.4350	1.9493
R(6)	7	.040 X .060	0.4959	1.9493
R(7)	8	.040 X .060	0.5568	1.9493
R(8)	9	.040 X .060	0.6177	1.9493
R(9)	10	.040 X .060	0.6786	1.9493
R(10)	11	.040 X .060	0.7395	1.9493
R(11)	12	.040 X .060	0.8004	1.9493
R(12)	13	.040 X .060	0.8613	1.9493
R(13)	14	.040 X .060	0.9222	1.9493
R(14)	15	.040 X .060	0.9831	1.9493
R(15)	16	.040 X .060	1.0440	1.9493
R(16)	17	.040 X .060	1.1049	1.9493
R(17)	18	.040 X .060	1.1658	1.9493
R(18)	19	.040 X .060	1.2267	1.9493
R(19)	20	.040 X .060	1.2876	1.9493
R(20)	21	.040 X .060	1.3485	1.9493
R(21)	22	.040 X .060	1.4094	1.9493
R(22)	23	.040 X .060	1.4703	1.9493
R(23)	24	.040 X .060	1.5312	1.9493
R(24)	25	.040 X .060	1.5921	1.9493
R(25)	26	.040 X .060	1.6530	1.9493
R(26)	27	.040 X .060	1.7139	1.9493
R(27)	28	.040 X .060	1.7748	1.9493
R(28)	29	.040 X .060	1.8357	1.9493
R(29)	30	.040 X .060	1.8966	1.9493
R(30)	31	.040 X .060	1.9575	1.9493
R(31)	32	.040 X .060	2.0184	1.9493
R(32)	33	.040 X .060	2.0793	1.9493
R(33)	34	.040 X .060	2.1402	1.9493
R(34)	35	.040 X .060	2.2011	1.9493
R(35)	36	.040 X .060	2.2620	1.9493
R(36)	37	.040 X .060	2.3229	1.9493
R(37)	38	.040 X .060	2.3838	1.9493
R(38)	39	.040 X .060	2.4447	1.9493
R(39)	40	.040 X .060	2.5056	1.9493

NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
R(40)	41	.040 X .060	2.5665	1.9493
R(41)	42	.040 X .060	2.6274	1.9493
R(42)	43	.040 X .060	2.6883	1.9493
R(43)	44	.040 X .060	2.7492	1.9493
R(44)	45	.040 X .060	2.8101	1.9493
R(45)	46	.040 X .060	2.8710	1.9493
R(46)	47	.040 X .060	2.9319	1.9493
R(47)	48	.040 X .060	2.9928	1.9493
R(48)	49	.040 X .060	3.0537	1.9493
R(49)	50	.040 X .060	3.1146	1.9493
R(50)	51	.040 X .060	3.1755	1.9493
R(51)	52	.040 X .060	3.2364	1.9493
R(52)	53	.040 X .060	3.2973	1.9493
R(53)	54	.040 X .060	3.3582	1.9493
R(54)	55	.040 X .060	3.4191	1.9493
R(55)	56	.040 X .060	3.4800	1.9493
R(56)	57	.040 X .060	3.5409	1.9493
R(57)	58	.040 X .060	3.6018	1.9493
R(58)	59	.040 X .060	3.6627	1.9493
R(59)	60	.040 X .060	3.7236	1.9493
R(60)	61	.040 X .060	3.7845	1.9493
R(61)	62	.040 X .060	3.8454	1.9493
R(62)	63	.040 X .060	3.9063	1.9493
R(63)	64	.040 X .060	3.9672	1.9493
R(64)	65	.040 X .060	4.0281	1.9493
R(65)	66	.040 X .060	4.0890	1.9493
R(66)	67	.040 X .060	4.1499	1.9493
R(67)	68	.040 X .060	4.2108	1.9493
R(68)	69	.040 X .060	4.2717	1.9493
R(69)	70	.040 X .060	4.3326	1.9493
R(70)	71	.040 X .060	4.3935	1.9493
R(71)	72	.040 X .060	4.4544	1.9493
R(72)	73	.040 X .060	4.5153	1.9493
R(73)	74	.040 X .060	4.5762	1.9493
R(74)	75	.040 X .060	4.6371	1.9493
R(75)	76	.040 X .060	4.6980	1.9493
R(76)	77	.040 X .060	4.7589	1.9493
R(77)	78	.040 X .060	4.8198	1.9493
R(78)	79	.040 X .060	4.8807	1.9493
R(79)	80	.040 X .060	4.9416	1.9493

Interface I/O – Lower Left

NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
R(80)	81	.040 X .060	5.0025	1.9493
R(81)	82	.040 X .060	5.0634	1.9493
R(82)	83	.040 X .060	5.1243	1.9493
R(83)	84	.040 X .060	5.1852	1.9493
R(84)	85	.040 X .060	5.2461	1.9493
R(85)	86	.040 X .060	5.3070	1.9493
R(86)	87	.040 X .060	5.3679	1.9493
R(87)	88	.040 X .060	5.4288	1.9493
R(88)	89	.040 X .060	5.4897	1.9493
R(89)	90	.040 X .060	5.5506	1.9493
R(90)	91	.040 X .060	5.6115	1.9493
R(91)	92	.040 X .060	5.6724	1.9493
R(92)	93	.040 X .060	5.7333	1.9493
R(93)	94	.040 X .060	5.7942	1.9493
R(94)	95	.040 X .060	5.8551	1.9493
R(95)	96	.040 X .060	5.9160	1.9493
R(96)	97	.040 X .060	5.9769	1.9493
R(97)	98	.040 X .060	6.0378	1.9493
R(98)	99	.040 X .060	6.0987	1.9493
R(99)	100	.040 X .060	6.1596	1.9493
R(100)	101	.040 X .060	6.2205	1.9493
R(101)	102	.040 X .060	6.2814	1.9493
R(102)	103	.040 X .060	6.3423	1.9493
R(103)	104	.040 X .060	6.4032	1.9493
R(104)	105	.040 X .060	6.4641	1.9493
R(105)	106	.040 X .060	6.5250	1.9493
R(106)	107	.040 X .060	6.5859	1.9493
R(107)	108	.040 X .060	6.6468	1.9493
R(108)	109	.040 X .060	6.7077	1.9493
R(109)	110	.040 X .060	6.7686	1.9493
R(110)	111	.040 X .060	6.8295	1.9493
R(111)	112	.040 X .060	6.8904	1.9493
R(112)	113	.040 X .060	6.9513	1.9493
R(113)	114	.040 X .060	7.0122	1.9493
R(114)	115	.040 X .060	7.0731	1.9493
R(115)	116	.040 X .060	7.1340	1.9493
R(116)	117	.040 X .060	7.1949	1.9493
R(117)	118	.040 X .060	7.2558	1.9493
R(118)	119	.040 X .060	7.3167	1.9493
R(119)	120	.040 X .060	7.3776	1.9493

NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
R(120)	121	.040 X .060	7.4385	1.9493
R(121)	122	.040 X .060	7.4994	1.9493
R(122)	123	.040 X .060	7.5603	1.9493
R(123)	124	.040 X .060	7.6212	1.9493
R(124)	125	.040 X .060	7.6821	1.9493
R(125)	126	.040 X .060	7.7430	1.9493
R(126)	127	.040 X .060	7.8039	1.9493
R(127)	128	.040 X .060	7.8648	1.9493
R(128)	129	.040 X .060	7.9257	1.9493
R(129)	130	.040 X .060	7.9866	1.9493
R(130)	131	.040 X .060	8.0475	1.9493
R(131)	132	.040 X .060	8.1084	1.9493
R(132)	133	.040 X .060	8.1693	1.9493
R(133)	134	.040 X .060	8.2302	1.9493
R(134)	135	.040 X .060	8.2911	1.9493
R(135)	136	.040 X .060	8.3520	1.9493
R(136)	137	.040 X .060	8.4129	1.9493
R(137)	138	.040 X .060	8.4738	1.9493
R(138)	139	.040 X .060	8.5347	1.9493
R(139)	140	.040 X .060	8.5956	1.9493
R(140)	141	.040 X .060	8.6565	1.9493
R(141)	142	.040 X .060	8.7174	1.9493
R(142)	143	.040 X .060	8.7783	1.9493
R(143)	144	.040 X .060	8.8392	1.9493
R(144)	145	.040 X .060	8.9001	1.9493
R(145)	146	.040 X .060	8.9610	1.9493
R(146)	147	.040 X .060	9.0219	1.9493
R(147)	148	.040 X .060	9.0828	1.9493
R(148)	149	.040 X .060	9.1437	1.9493
R(149)	150	.040 X .060	9.2046	1.9493
R(150)	151	.040 X .060	9.2655	1.9493
R(151)	152	.040 X .060	9.3264	1.9493
R(152)	153	.040 X .060	9.3873	1.9493
R(153)	154	.040 X .060	9.4482	1.9493
R(154)	155	.040 X .060	9.5091	1.9493
R(155)	156	.040 X .060	9.5700	1.9493
R(156)	157	.040 X .060	9.6309	1.9493
R(157)	158	.040 X .060	9.6918	1.9493
R(158)	159	.040 X .060	9.7527	1.9493
R(159)	160	.040 X .060	9.8136	1.9493
R(159)	161	.085 X .085	9.9362	1.9368

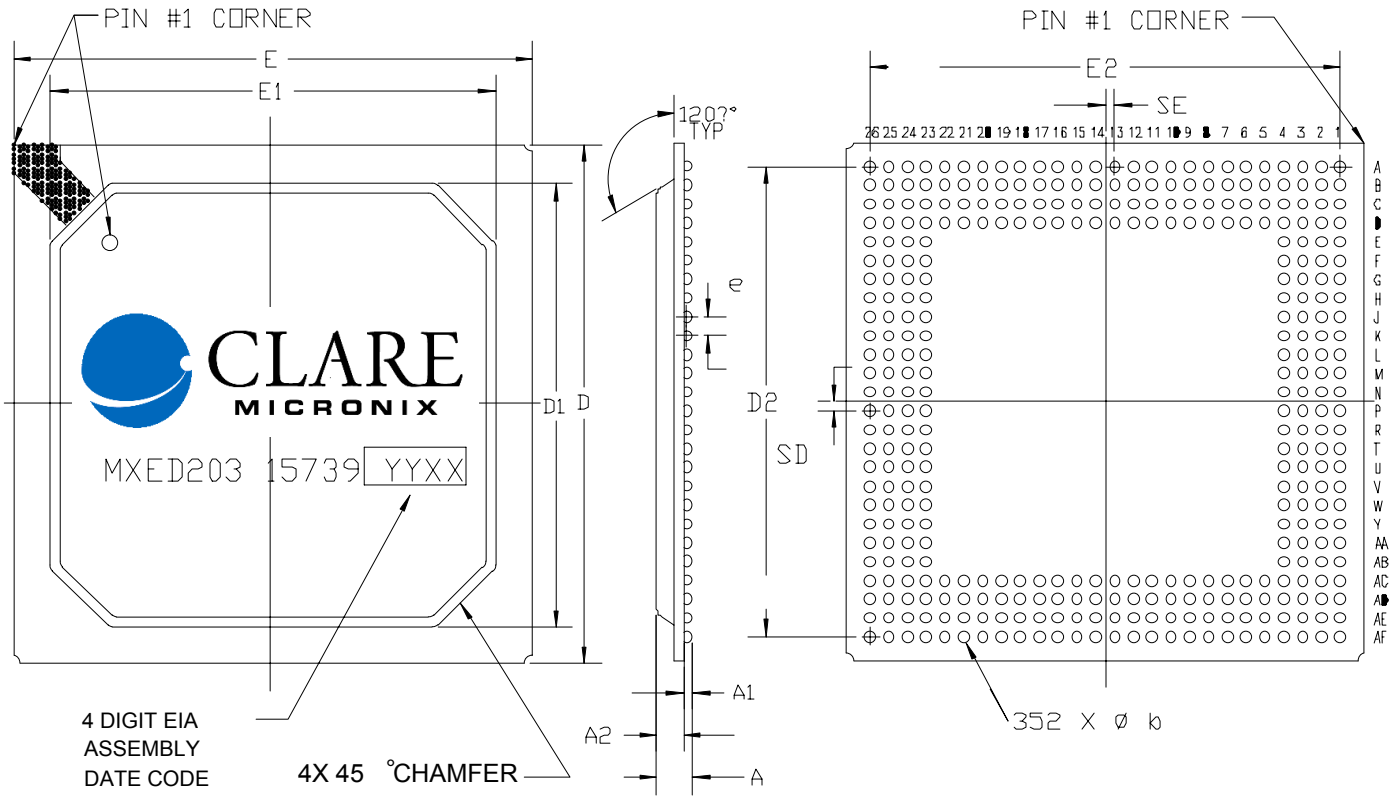
NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
R(159)	161	.085 X .085	9.9362	1.9368
RTN	162	.085 X .085	9.9362	1.6810
RTN*	163	.060 X .040	9.9487	1.5954
RTN*	164	.060 X .040	9.9487	1.5354
RTN*	165	.060 X .040	9.9487	1.4754
RTN*	166	.060 X .040	9.9487	1.4154
RTN	167	.085 X .085	9.9362	1.3298
VOH*	168	.060 X .040	9.9487	1.0662
VOH*	169	.060 X .040	9.9487	1.0062
VOH	170	.085 X .085	9.9362	0.9206
VCC	171	.085 X .085	9.9205	0.0125
VCC	172	.040 X .060	9.8349	0.0000
VCC	173	.040 X .060	9.7749	0.0000
GND	174	.085 X .085	9.6846	0.0125
GND	175	.040 X .060	9.5990	0.0000
GND	176	.040 X .060	9.5390	0.0000
GND	177	.085 X .085	9.3999	0.0125
GND	178	.040 X .060	9.3143	0.0000
GND	179	.040 X .060	9.2543	0.0000
GND	180	.085 X .085	9.1640	0.0125
GND	181	.040 X .060	9.0784	0.0000
GND	182	.040 X .060	9.0184	0.0000
VMAX	183	.085 X .085	8.9281	0.0125
VMAX	184	.040 X .060	8.8425	0.0000
VMAX	185	.040 X .060	8.7825	0.0000
SLIN	186	.085 X .085	8.6434	0.0125
SLIN	187	.040 X .060	8.5578	0.0000
SLIN	188	.040 X .060	8.4978	0.0000
SHR	189	.085 X .085	8.3039	0.0125
SHR	190	.040 X .060	8.2183	0.0000
SHR	191	.040 X .060	8.1583	0.0000
DUAL	192	.085 X .085	8.0192	0.0125
DUAL	193	.040 X .060	7.9336	0.0000
DUAL	194	.040 X .060	7.8736	0.0000
RSTN	195	.085 X .085	7.7345	0.0125
RSTN	196	.040 X .060	7.6489	0.0000
RSTN	197	.040 X .060	7.5889	0.0000
LREF	198	.040 X .060	7.4055	0.0000
LREF	199	.040 X .060	7.3455	0.0000
LREF	200	.085 X .085	7.2599	0.0125

NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
DUMMY3	201	.040 X .060	7.1667	0.0000
DUMMY3	202	.040 X .060	7.1067	0.0000
DUMMY3	203	.085 X .085	7.0211	0.0125
GND	204	.085 X .085	6.8595	0.0125
GND	205	.040 X .060	6.7739	0.0000
GND	206	.040 X .060	6.7139	0.0000
DUMMY2	207	.085 X .085	6.6236	0.0125
DUMMY2	208	.040 X .060	6.5380	0.0000
DUMMY2	209	.040 X .060	6.4780	0.0000
HREF	210	.085 X .085	6.3848	0.0125
HREF	211	.040 X .060	6.2992	0.0000
HREF	212	.040 X .060	6.2392	0.0000
S160	213	.085 X .085	5.9845	0.0125
S160	214	.040 X .060	5.8989	0.0000
S160	215	.040 X .060	5.8389	0.0000
ROPT	216	.040 X .060	5.7709	0.0000
ROPT	217	.040 X .060	5.7109	0.0000
ROPT	218	.085 X .085	5.6255	0.0125
PCB	219	.085 X .085	5.1947	0.0125
PCB	220	.040 X .060	5.1091	0.0000
PCB	221	.040 X .060	5.0491	0.0000
CLK	222	.085 X .085	4.9100	0.0125
CLK	223	.040 X .060	4.8244	0.0000
CLK	224	.040 X .060	4.7644	0.0000
VCC	225	.085 X .085	4.5850	0.0125
VCC	226	.040 X .060	4.4994	0.0000
VCC	227	.040 X .060	4.4394	0.0000
VCC	228	.085 X .085	4.3530	0.0125
VCC	229	.040 X .060	4.2674	0.0000
VCC	230	.040 X .060	4.2074	0.0000
GND	231	.040 X .060	4.1474	0.0000
GND	232	.040 X .060	4.0874	0.0000
GND	233	.085 X .085	4.0018	0.0125
GND	234	.040 X .060	3.9154	0.0000
GND	235	.040 X .060	3.8554	0.0000
GND	236	.085 X .085	3.7698	0.0125
SRIN	237	.040 X .060	3.5467	0.0000
SRIN	238	.040 X .060	3.4867	0.0000
SRIN	239	.085 X .085	3.4011	0.0125
DRV	240	.040 X .060	3.2611	0.0000

NET	PAD #	BUMP SIZE (mm)	X(mm)	Y(mm)
DRV	241	.040 X .060	3.2011	0.0000
DRV	242	.085 X .085	3.1157	0.0125
INV	243	.040 X .060	2.8318	0.0000
INV	244	.040 X .060	2.7718	0.0000
INV	245	.085 X .085	2.6864	0.0125
DUMMY1	246	.040 X .060	1.4839	0.0000
DUMMY1	247	.040 X .060	1.4239	0.0000
DUMMY1	248	.085 X .085	1.3383	0.0125
SLPB	249	.085 X .085	1.1095	0.0125
SLPB	250	.040 X .060	1.0239	0.0000
SLPB	251	.040 X .060	0.9639	0.0000
GND	252	.040 X .060	0.3940	0.0000
GND	253	.040 X .060	0.3340	0.0000
GND	254	.085 X .085	0.2484	0.0125
VCC	255	.040 X .060	0.1581	0.0000
VCC	256	.040 X .060	0.0981	0.0000
VCC	257	.085 X .085	0.0125	0.0125
VMAX*	258	.060 X .040	0.0000	0.2890
VMAX	259	.085 X .085	0.0125	0.3746
VOH	260	.085 X .085	0.0125	0.9206
VOH*	261	.060 X .040	0.0000	1.0062
VOH*	262	.060 X .040	0.0000	1.0662
RTN	263	.085 X .085	0.0125	1.3298
RTN*	264	.060 X .040	0.0000	1.4154
RTN*	265	.060 X .040	0.0000	1.4754
RTN*	266	.060 X .040	0.0000	1.5354
RTN*	267	.060 X .040	0.0000	1.5954
RTN	268	.085 X .085	0.0125	1.6810
R(0)	269	.085 X .085	0.0125	1.9368

* Note that the majority of rectangular pads are .040 x .060. However, the rectangular pads on the end are rotated, and thus are labelled 060 x .040.

BGA SPECIFICATIONS



SYMBOL	DIMENSION IN INCH			DIMENSION IN MM		
	MIN.	NOM	MAX.	MIN.	NOM	MAX.
A	0.085	0.094	0.098	2.17	2.38	2.59
A1	0.020	0.024	0.028	0.50	0.60	0.70
A2	0.064	0.068	0.072	1.67	1.78	1.89
b	0.024	0.031	0.035	0.60	0.79	0.90
D	1.374	1.378	1.382	34.90	35.00	35.10
D1	1.175	1.181	1.187	29.85	30.00	30.15
E	1.374	1.378	1.382	34.90	35.00	35.10
E1	1.175	1.181	1.187	29.85	30.00	30.15
E2	1.25			31.75		
e	0.05			1.27		
D2	1.25			31.75		
SD	0.025			0.635		
SE	0.025			0.635		
JEDEC	MO-151(REF.)					

BGA PAD LOCATIONS

NET	BALL
R(0)	T26
R(1)	AB24
R(2)	R25
R(3)	AB23
R(4)	R26
R(5)	AC26
R(6)	N26
R(7)	AC25
R(8)	N25
R(9)	AC24
R(10)	K23
R(11)	AC23
R(12)	B20
R(13)	L23
R(14)	AF24
R(15)	A20
R(16)	J23
R(17)	AD23
R(18)	N23
R(19)	C19
R(20)	AE23
R(21)	M23
R(22)	AF23
R(23)	R23
R(24)	AC22
R(25)	AC19
R(26)	AD22
R(27)	T23
R(28)	AE22
R(29)	C18
R(30)	R24
R(31)	AF22
R(32)	U23
R(33)	B18
R(34)	AC21
R(35)	V23
R(36)	A18
R(37)	AD21
R(38)	AD26
R(39)	C17

NET	BALL
R(40)	AE21
R(41)	AC18
R(42)	B17
R(43)	AF21
R(44)	AC17
R(45)	AC20
R(46)	A17
R(47)	AC16
R(48)	AD20
R(49)	AD24
R(50)	C16
R(51)	AE20
R(52)	AE25
R(53)	AF20
R(54)	AD19
R(55)	B16
R(56)	AE19
R(57)	A16
R(58)	AE24
R(59)	AF19
R(60)	AF25
R(61)	C15
R(62)	AD18
R(63)	B15
R(64)	AC15
R(65)	AE18
R(66)	AD25
R(67)	A15
R(68)	AF18
R(69)	D19
R(70)	A13
R(71)	AD17
R(72)	AC12
R(73)	AE17
R(74)	B13
R(75)	AC11
R(76)	AF17
R(77)	AC10
R(78)	C13
R(79)	AD16

NET	BALL
R(80)	AC4
R(81)	AF16
R(82)	AC9
R(83)	A12
R(84)	B12
R(85)	AD15
R(86)	C12
R(87)	AC8
R(88)	AE15
R(89)	A11
R(90)	AC14
R(91)	AF15
R(92)	AC5
R(93)	AD14
R(94)	C11
R(95)	AC6
R(96)	AE14
R(97)	AC7
R(98)	AF14
R(99)	AD3
R(100)	AF12
R(101)	B10
R(102)	D4
R(103)	AE12
R(104)	A9
R(105)	D11
R(106)	AD12
R(107)	AD2
R(108)	AF11
R(109)	AE11
R(110)	E4
R(111)	B9
R(112)	AD11
R(113)	Y4
R(114)	C9
R(115)	AA4
R(116)	AD10
R(117)	AB4
R(118)	AF9
R(119)	H4

NET	BALL
R(120)	B8
R(121)	AE9
R(122)	W4
R(123)	AD9
R(124)	G4
R(125)	AF8
R(126)	A7
R(127)	J4
R(128)	AE8
R(129)	B7
R(130)	K4
R(131)	AD8
R(132)	L4
R(133)	C7
R(134)	AF7
R(135)	U4
R(136)	A6
R(137)	AE7
R(138)	V4
R(139)	AD7
R(140)	B6
R(141)	M4
R(142)	AF6
R(143)	C6
R(144)	T4
R(145)	A5
R(146)	AE6
R(147)	R4
R(148)	B5
R(149)	AD6
R(150)	C5
R(151)	T1
R(152)	AF5
R(153)	T2
R(154)	A4
R(155)	AE5
R(156)	T3
R(157)	AD5
R(158)	U1
R(159)	U2

NET	BALL
RTN	R2
RTN	R1
VOH	P3
VCC	K1
GND	L2
GND	L1
RTN	M1
VOH	M2
SLIN	F4
SHR	D12
DUAL	D6
RSTN	C8
LREF	A8
GND	D2
HREF	C10
S160	A10
ROPT	B11
PCB	D8
CLK	D10
VCC	D9
VCC	D13
GND	D16
GND	D15
SRIN	D17
DRV	D18
INV	D21
SLPB	H23
GND	B21
VCC	K24
VMAX	L24
VOH	M24
RTN	M25
RTN	M26

ORDERING INFORMATION

MXED203

Ordering Part Number	Package
15701-00	Gold Bumped Die in Waffle Trays
15726-00	Gold Bumped Die in Wafer Form
15735-00	TCP (Tape Carrier Package) please consult factory
15739-00	BGA (typically for prototyping only)

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