The Data Matrix Symbology and ERROR CORRECTION LEVELS

The Data Matrix symbology, when first released, used a type of error correction called "Convolutional Coding". Later, to win adoption by the standards bodies, the ECC 200 AIM Spec was released which employed a new type of error correction, based on REED SOLOMON principles. Upon this release, there was a set of codes made obsolete because the upper right hand corner had the wrong polarity to tell the difference between error correction schemes. Unfortunately, there are people still using obsolete decoders and you may encounter them. Specifically, any EVEN NUMBERED ECC BELOW 100 (40, 60, 80) IS OBSOLETE, INVALID, AND, TECHNICALLY SHOULD NOT TO BE DECODED.

Just to add to the confusion, other lower level ECC's: 0, 50, 80, 100, 140 that use Convolutional rather than Reed-Solomon error correction WERE ALLOWED TO CARRY FORWARD, HOWEVER these ECC levels have disadvantages due to the amount of overhead caused by the Convolutional algorithm. Further, the ECC 200 Spec., and EIA and AIAG specs for applications require ECC 200 for open system applications. The reasons for this are data capacity versus error correction versus overhead.

ECC 200 codes are fixed at a repair level of about 25% damage and overhead ranges from 60% for a small number of characters downward to 26% for a large number of characters encoded.

The typical overhead for REED-SOLOMON in the ECC 200 symbology is about 30% of the encoded data. This must be compared to the following Convolutional levels of repairable damage percent and the corresponding levels of overhead apply:

ECC	DamRecv	Ohd
000	0%	0% (NO ERROR RECOVERY)
050	3%	33%
080	5%	50%
100	12.5%	100%
140	25%	300%

What this means, is that, for a given element size, you can pack far less information in the same area with the Convolutional ECC's with the same level of damage recovery.

That's the long answer for why we don't support ECC's lower than 200, and the reason that anyone who is making new symbols with the old format should quit.

Further on the subject of REED-SOLOMON ERROR CORRECTION

Most modern 2D symbologies use the form of error correction based on Reed-Solomon principles, named after the MIT scientists who developed them about forty years ago, and first published in a five-page paper that appeared in 1960 in the Journal of the Society for Industrial and Applied Mathematics. The paper, "Polynomial Codes over Certain Finite Fields," by Irving S. Reed and Gustave Solomon, then staff members at MIT's Lincoln Laboratory, established the principles for forward error correction that have since been deployed in everything from disc drives to deep space probe radio transmissions. In basic terms, in addition to the data, additional information is sent with the data in order to detect any errors and correct the data errors by mathematically reconstructing the information. This is an important feature due to the high probability of partial damage to labels and permanently marked symbols in the shipping, construction, mission, and recovery processes. Reed, later a professor at California's U.S.C., consulted for the Jet Propulsion Laboratory on projects to insure of the receipt of correct data in transmissions involving space exploration, as related in the Society for Industrial and Applied Mathematics Newsletter in January 1993. Following is a chart showing data capacity and symbol size using ECC 200 DataMatrix.

Symbol Size[1] Row	Symbol Size[1] Col	Data Region Size	Data Region Number	Mapping Matrix Size	Total Codewords Data	Total Codewords Error	Reed-Solomon Block Data	Reed-Solomon Block Error	Inter-leaved Blocks	Data Capacity Num. Cap.	Data Capacity Alphanum. Cap.	Data Capacity Byte Cap.	Error Correction Overhead %	Max. Correctable Codeword Error/Erasure
10	10	8x8	1	8x8	3	5	3	5	1	6	3	1	62.5	2/+
12	12	10x10	1	10x10	5	7	5	7	1	10	6	3	58.3	3/+
14	14	12x12	1	12x12	8	10	8	10	1	16	10	6	55.6	5/7
16	16	14x14	1	14x14	12	12	12	12	1	24	16	10	50	6/9
18	18	16x16	1	16x16	18	14	18	14	1	36	25	16	43.8	7/11
20	20	18x18	1	18x18	22	18	22	18	1	44	31	20	45	9/15
22	22	20x20	1	20x20	30	20	30	20	1	60	43	28	40	10/17
24	24	22x22	1	22x22	36	24	36	24	1	72	52	34	40	12/21
26	26	24x24	1	24x24	44	28	44	28	1	88	64	42	38.9	14/25
32	32	14x14	4	28x28	62	36	62	36	1	124	91	60	36.7	18/33
36	36	16x16	4	32x32	86	42	86	42	1	172	127	84	32.8	21/39
40	40	18x18	4	36x36	114	48	114	48	1	228	169	112	29.6	24/45
44	44	20x20	4	40x40	144	56	144	56	1	288	214	142	28	28/53
48	48	22x22	4	44x44	174	68	174	68	1	348	259	172	28.1	34/65
52	52	24x24	4	48x48	204	84	102	42	2	408	304	202	29.2	42/78
64	64	14x14	16	56x56	280	112	140	56	2	560	418	278	28.6	56/106
72	72	16x16	16	64x64	368	144	92	36	4	736	550	366	28.1	72/132
80	80	18x18	16	72x72	456	192	114	48	4	912	682	454	29.6	96/180
88	88	20x20	16	80x80	576	224	144	56	4	1152	862	574	28	112/212
96	96	22x22	16	88x88	696	272	174	68	4	1392	1042	694	28.1	136/260
104	104	24x24	16	96x96	816	336	136	56	6	1632	1222	814	29.2	168/318
120	120	18x18	36	108x108	1050	408	175	68	6	2100	1573	1048	28	204/390
132	132	20x20	36	120x120	1304	496	163	62	8	2608	1954	1302	27.6	248/472
144	144	22x22	36	132x132	1558	620	156	62	8*	3116	2335	1556	28.5	310/590
							155	62	2*					

Rectangular Symbols

Row	Col	Data Region Size	Data Region Number	Mapping Matrix Size	Total Codewords Data	Total Codewords Error	Reed-Solomon Block Data	Reed-Solomon Block Error	Inter-leaved Blocks	Num. Cap.	Alphanum. Cap.	Byte Cap.	Error Correction Overhead %	Max. Correctable Codeword Error/Erasure
8	18	6x16	1	6x16	5	7	5	7	1	10	6	3	58.3	3/+
8	32	6x14	2	6x28	10	11	10	11	1	20	13	8	52.4	5/+
12	26	10x24	1	10x24	16	14	16	14	1	32	22	14	46.7	7/11
12	36	10x16	2	10x32	22	18	22	18	1	44	31	20	45.0	9/15
16	36	14x16	2	14x32	32	24	32	24	1	64	46	30	42.9	12/21
16	48	14x22	2	14x44	49	28	49	28	1	98	72	47	36.4	14/25

Note 1: Symbol size does not include quiet zone.

*Note: In the largest symbol (144x144), the first eight Reed-Solomon blocks shall be 218 codewords long encoding 156 data codewords. The last two blocks shall encode 217 codewords (155 data codewords). All the blocks have 62 error correction codewords.

+Note: Does not apply

Table 11: ECC 200 Symbol Attributes