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GROUND BEACON

DME 415/435

Technical Manual

VOLUME 1

Equipment description, Installation, Operation, Maintenance and PC user

SECTION 1

GENERAL INFORMATION

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SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

DME (*D*istance *M*easuring *E*quipment) has been standardized by the ICAO as a radio aid for short and medium-distance navigation. It is a secondary type of radar, which allows several aircraft to simultaneously measure their distance from a ground reference (DME transponder). The distance is determined by measuring the propagation delay of a RF pulse, which is emitted by the aircraft transmitter and returned at a different frequency by the ground station after reception.

In conjunction with a VOR, the DME, which should preferably be installed at the same location as a VOR/DME, enables to determine the direction and the distance (rho-theta method).

Since the DME operates in the same frequency range (960 to 1215 MHz) and according to the same principle as the distance measuring section of the TACAN, combined VOR/TACAN systems (VORTAC) are installed in many countries, as well as VOR/DME systems.

1.2 DME PRINCIPLE

Aircraft's equipped with DME transmit encoded interrogating RF pulse pairs on the beacon's receiving channel. The beacon, in turn, emits encoded reply pulse pairs on the receiving channel of the air-borne equipment, which is 63 MHz apart from the transmitter frequency former.

The time interval between interrogation emission and reply reception provides the aircraft with the real distance information from the ground station; this information may be read by the pilot or the navigator directly on the airborne indicator.
The ground transponder is able to answer up to about 200 interrogators at a time (i.e. 4800 pulse pairs/s). Generates random pulse pairs ("squitter") to maintain a minimum PRF of 800 to 2700 pulse pairs per second (programmable) whenever the number of decoded interrogations is lower than that.

This reply is received and decoded by the airborne receiver, where special timing circuits automatically measure the lapse between interrogation and reply and convert this measurement into electrical output signals. The beacon introduces a fixed delay, called *reply delay,* between the reception of each encoded interrogating pulse pair and the transmission of the corresponding reply (see Figure 1.1).

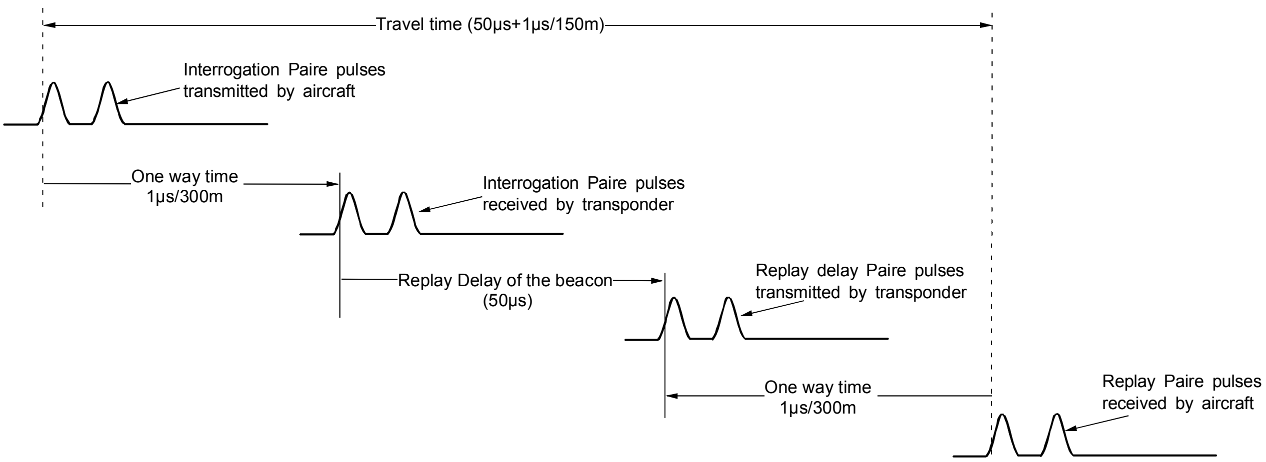


Figure 1.1. DME - Principle of the RF signals path

The transponder periodically transmits special identification pulse groups, interleaved with the reply and squitter pulses that can be decoded by the aircraft as a Morse tone, keyed with the beacon code name.

The airborne receiver is able to recognize the replies to its own interrogations, among the many other pulses transmitted by the beacon, by means of a stroboscopic procedure.

The DME theory of operation is summarized in a block diagram in Figure 1.2.

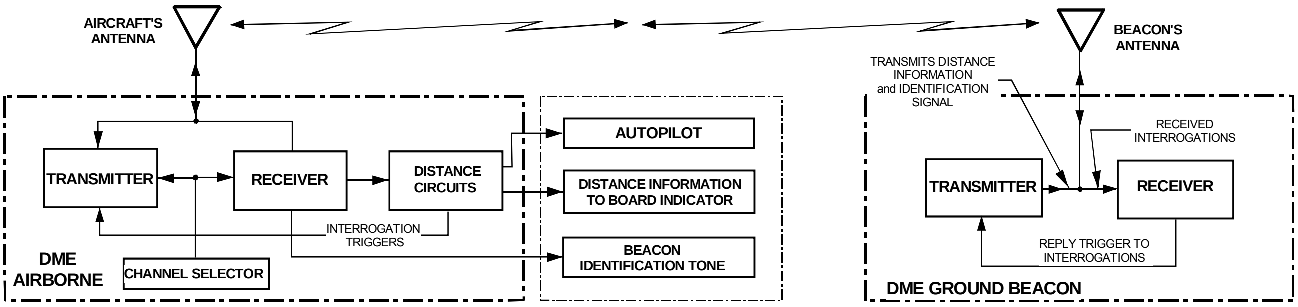


Figure 1.2. DME - Theory of operation, simplified block diagram

1.2.1 Coverage

According to the frequency band used, the DME system coverage is limited to the optical range and depends on the aircraft flight altitude and on the type of ground.
The high frequency used and the use of special techniques have made the system much less sensitive to site errors than other types of omni-directional beacons now in use.

1.2.2 Traffic Capacity

The aircraft handling capacity is adequate for a traffic peak of 200 aircrafts. When the traffic peak exceeds 200 aircrafts the transponder should be capable of handling that peak.

1.2.3 Accuracy

As a result of the development and the applications of modern electronic technologies, the accuracy of the distance information provided by the DME system is improving all the time.
At present, the accuracy of a DME system can be considered within the maximum values specified below: ±0.12 NM +0.05% of the distance, from 0 to 65 nautical miles, and ± 0.17 NM +0.05% of the distance, above 65 nautical miles.

1.2.4 Nominal Reply Delay – Pair Pulse Code - Channeling

Each beacon is identified by means of its channel frequency, its pulse coding and its identity signal.
The ground beacon introduces a fixed delay between the reception of interrogating pulses and the transmission of the corresponding reply pulses.
This fixed delay, called main delay or fundamental delay, is introduced. So that an aircraft which is flying very close to the beacon can complete transmission of the encoded interrogating pulse pair, and then deactivate its own transmitter, before its receiver begins receiving the corresponding beacon reply pulses.

To render the system as immune as possible to errors caused by interfering signals, the DME system transmits pulse pairs instead of single pulses; each pair includes two 3.5 μs pulses whose spacing depends on the channel mode selected.
The channel code, pulse code, reply delay and operating mode are shown on the following table (standard ICAO).

Channel Code	Nominal Interrogation Pulse Code [μs]	Transponder Reply Pulse Code [μs]	Transponder Nominal Reply Delay [μs]
X	12	12.0 ± 0.1	50
Y	36	30.0 ± 0.1	56

Each operational channel in the DME system is defined by two frequencies (interrogation and reply frequencies), spaced 63 MHz apart, and by the pulse code for the assigned channel (X or Y channel).
The DME system transmits on a pre-selected channel among the 252 available ones. These channels are divided into 126 X channels and 126 Y channels providing a frequency ranging from 1025 to 1150 MHz for aircraft transmission (interrogation). Moreover, a 962 to 1213 MHz frequency for signal reception by the aircraft (ground beacon reply transmission). Interrogation and reply frequencies are assigned with one MHz spacing between channels.
The diagram shown in figure 1.3 gives the aircraft interrogation frequency associated to the beacon reply frequency for both channel types X, Y. The same information is also given in table 1-1 and table 1-2 for X and Y channels respectively, as per ICAO ANNEX 10.
Each beacon emits a Morse identity code signal that can be heard in the pilot headset; this code consists of pulse pairs transmitted at a frequency of 1350 Hz.
Each beacon is therefore identified by means of its channel frequency, its pulse coding and its identity signal.

Table 1-1. Frequencies for DME Channels

X Channels (n° 126)	Channel	**Y Channels (n° 126)**
I = 1025 + (CH-1)		I = 1025 + (CH-1)
R = I - 63	$1 \leq CH \leq 63$	R = I + 63
R = I + 63	$64 \leq CH \leq 126$	R = I - 63

I = INTERROGATION FREQUENCY (MHz)
R = REPLY FREQUENCY (MHz)
CH = CHANNEL NUMBER

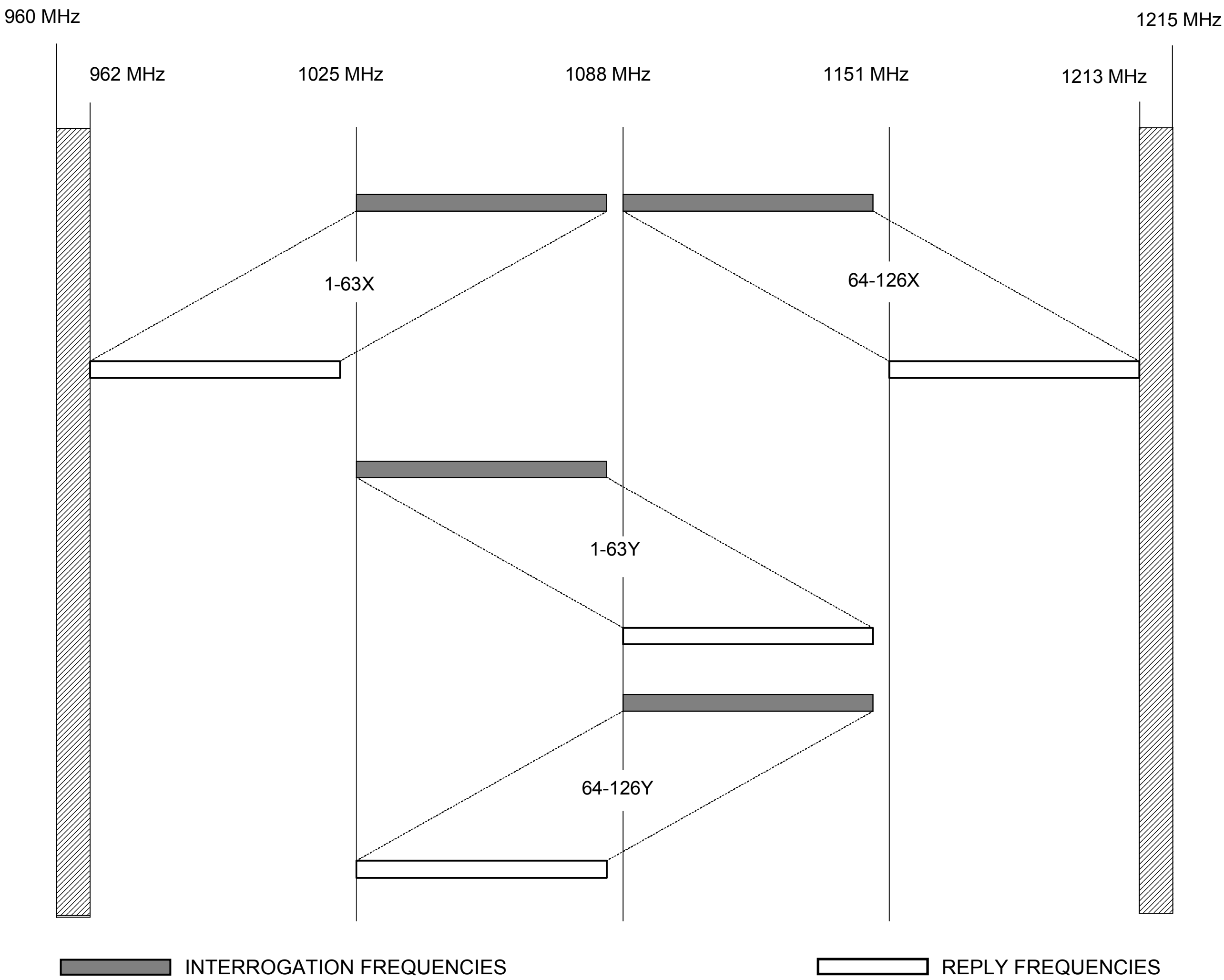


Figure 1.3. DME Channels Reply and Interrogation Frequencies

Table 1-2. Frequencies and Code Pulses for DME Channels (1 to 17)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
1X	–	–	–	1025	12	–	–	962	12
1Y	–	–	–	1025	36	–	–	1088	30
2X	–	–	–	1026	12	–	–	963	12
2Y	–	–	–	1026	36	–	–	1089	30
3X	–	–	–	1027	12	–	–	964	12
3Y	–	–	–	1027	36	–	–	1090	30
4X	–	–	–	1028	12	–	–	965	12
4Y	–	–	–	1028	36	–	–	1091	30
5X	–	–	–	1029	12	–	–	966	12
5Y	–	–	–	1029	36	–	–	1092	30
6X	–	–	–	1030	12	–	–	967	12
6Y	–	–	–	1030	36	–	–	1093	30
7X	–	–	–	1031	12	–	–	968	12
7Y	–	–	–	1031	36	–	–	1094	30
8X	–	–	–	1032	12	–	–	969	12
8Y	–	–	–	1032	36	–	–	1095	30
9X	–	–	–	1033	12	–	–	970	12
9Y	–	–	–	1033	36	–	–	1096	30
10X	–	–	–	1034	12	–	–	971	12
10Y	–	–	–	1034	36	–	–	1097	30
11X	–	–	–	1035	12	–	–	972	12
11Y	–	–	–	1035	36	–	–	1098	30
12X	–	–	–	1036	12	–	–	973	12
12Y	–	–	–	1036	36	–	–	1099	30
13X	–	–	–	1037	12	–	–	974	12
13Y	–	–	–	1037	36	–	–	1100	30
14X	–	–	–	1038	12	–	–	975	12
14Y	–	–	–	1038	36	–	–	1101	30
15X	–	–	–	1039	12	–	–	976	12
15Y	–	–	–	1039	36	–	–	1102	30
16X	–	–	–	1040	12	–	–	977	12
16Y	–	–	–	1040	36	–	–	1103	30
17X	108.00	–	–	1041	12	–	–	978	12
17Y	108.05	5043.0	540	1041	36	36	42	1104	30
17Z	–	5043.3	541	1041	–	21	27	1104	15

Table 1-2. Frequencies and Code Pulses for DME Channels (18 to 28)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
18X	108.10	5031.0	500	1042	12	12	18	979	12
18W	–	5031.3	501	1042	–	24	30	979	24
18Y	108.15	5043.6	542	1042	36	36	42	1105	30
18Z	–	5043.9	543	1042	–	21	27	1105	15
19X	108.20	–	–	1043	12	–	–	980	12
19Y	108.25	5044.2	544	1043	36	36	42	1106	30
19Z	–	5044.5	545	1043	–	21	27	1106	15
20X	108.30	5031.6	502	1044	12	12	18	981	12
20W	–	5031.9	503	1044	–	24	30	981	24
20Y	108.35	5044.8	546	1044	36	36	42	1107	30
20Z	–	5045.1	547	1044	–	21	27	1107	15
21X	108.40	–	–	1045	12	–	–	982	12
21Y	108.45	5045.4	548	1045	36	36	42	1108	30
21Z	–	5045.7	549	1045	–	21	27	1108	15
22X	108.50	5032.2	504	1046	12	12	18	983	12
22W	–	5032.5	505	1046	–	24	30	983	24
22Y	108.55	5046.0	550	1046	36	36	42	1109	30
22Z	–	5046.3	551	1046	–	21	27	1109	15
23X	108.60	–	–	1047	12	–	–	984	12
23Y	108.65	5046.6	552	1047	36	36	42	1110	30
23Z	–	5046.9	553	1047	–	21	27	1110	15
24X	108.70	5032.8	506	1048	12	12	18	985	12
24W	–	5033.1	507	1048	–	24	30	985	24
24Y	108.75	5047.2	554	1048	36	36	42	1111	30
24Z	–	5047.5	555	1048	–	21	27	1111	15
25X	108.80	–	–	1049	12	–	–	986	12
25Y	108.85	5047.8	556	1049	36	36	42	1112	30
25Z	–	5048.1	557	1049	–	21	27	1112	15
26X	108.90	5033.4	508	1050	12	12	18	987	12
26W	–	5033.7	509	1050	–	24	30	987	24
26Y	108.95	5048.4	558	1050	36	36	42	1113	30
26Z	–	5048.7	559	1050	–	21	27	1113	15
27X	109.00	–	–	1051	12	–	–	988	12
27Y	109.05	5049.0	560	1051	36	36	42	1114	30
27Z	–	5049.3	561	1051	–	21	27	1114	15
28X	109.10	5034.0	510	1052	12	12	18	989	12
28W	–	5034.3	511	1052	–	24	30	989	24
28Y	109.15	5049.6	562	1052	36	36	42	1115	30
28Z	–	5049.9	563	1052	–	21	27	1115	15

Table 1-2. Frequencies and Code Pulses for DME Channels (29 to 40)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
29X	109.20	–	–	1053	12	–	–	990	12
29Y	109.25	5050.2	564	1053	36	36	42	1116	30
29Z	–	5050.5	565	1053	–	21	27	1116	15
30X	109.30	5034.6	512	1054	12	12	18	991	12
30W	–	5034.9	513	1054	–	24	30	991	24
30Y	109.35	5050.8	566	1054	36	36	42	1117	30
30Z	–	5051.1	567	1054	–	21	27	1117	15
31X	109.40	–	–	1055	12	–	–	992	12
31Y	109.45	5051.4	568	1055	36	36	42	1118	30
31Z	–	5051.7	569	1055	–	21	27	1118	15
32X	109.50	5035.2	514	1056	12	12	18	993	12
32W	–	5035.5	515	1056	–	24	30	993	24
32Y	109.55	5052.0	570	1056	36	36	42	1119	30
32Z	–	5052.3	571	1056	–	21	27	1119	15
33X	109.60	–	–	1057	12	–	–	994	12
33Y	109.65	5052.6	572	1057	36	36	42	1120	30
33Z	–	5052.9	573	1057	–	21	27	1120	15
34X	109.70	5035.8	516	1058	12	12	18	995	12
34W	–	5036.1	517	1058	–	24	30	995	24
34Y	109.75	5053.2	574	1058	36	36	42	1121	30
34Z	–	5053.5	575	1058	–	21	27	1121	15
35X	109.80	–	–	1059	12	–	–	996	12
35Y	109.85	5053.8	576	1059	36	36	42	1122	30
35Z	–	5054.1	577	1059	–	21	27	1122	15
36X	109.90	5036.4	518	1060	12	12	18	997	12
36W	–	5036.7	519	1060	–	24	30	997	24
36Y	109.95	5054.4	578	1060	36	36	42	1123	30
36Z	–	5054.7	579	1060	–	21	27	1123	15
37X	110.00	–	–	1061	12	–	–	998	12
37Y	110.05	5055.0	580	1061	36	36	42	1124	30
37Z	–	5055.3	581	1061	–	21	27	1124	15
38X	110.10	5037.0	520	1062	12	12	18	999	12
38W	–	5037.3	521	1062	–	24	30	999	24
38Y	110.15	5055.6	582	1062	36	36	42	1125	30
38Z	–	5055.9	583	1062	–	21	27	1125	15
39X	110.20	–	–	1063	12	–	–	1000	12
39Y	110.25	5056.2	584	1063	36	36	42	1126	30
39Z	–	5056.5	585	1063	–	21	27	1126	15
40X	110.30	5037.6	522	1064	12	12	18	1001	12
40W	–	5037.9	523	1064	–	24	30	1001	24
40Y	110.35	5056.8	586	1064	36	36	42	1127	30
40Z	–	5057.1	587	1064	–	21	27	1127	15

Table 1-2. Frequencies and Code Pulses for DME Channels (41 to 52)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
41X	110.40	–	–	1065	12	–	–	1002	12
41Y	110.45	5057.4	588	1065	36	36	42	1128	30
41Z	–	5057.7	589	1065	–	21	27	1128	15
42X	110.50	5038.2	524	1066	12	12	18	1003	12
42W	–	5038.5	525	1066	–	24	30	1003	24
42Y	110.55	5058.0	590	1066	36	36	42	1129	30
42Z	–	5058.3	591	1066	–	21	27	1129	15
43X	110.60	–	–	1067	12	–	–	1004	12
43Y	110.65	5058.6	592	1067	36	36	42	1130	30
43Z	–	5058.9	593	1067	–	21	27	1130	15
44X	110.70	5038.8	526	1068	12	12	18	1005	12
44W	–	5039.1	527	1068	–	24	30	1005	24
44Y	110.75	5059.2	594	1068	36	36	42	1131	30
44Z	–	5059.5	595	1068	–	21	27	1131	15
45X	110.80	–	–	1069	12	–	–	1006	12
45Y	110.85	5059.8	596	1069	36	36	42	1132	30
45Z	–	5060.1	597	1069	–	21	27	1132	15
46X	110.90	5039.4	528	1070	12	12	18	1007	12
46W	–	5039.7	529	1070	–	24	30	1007	24
46Y	110.95	5060.4	598	1070	36	36	42	1133	30
46Z	–	5060.7	599	1070	–	21	27	1133	15
47X	111.00	–	–	1071	12	–	–	1008	12
47Y	111.05	5061.0	600	1071	36	36	42	1134	30
47Z	–	5061.3	601	1071	–	21	27	1134	15
48X	111.10	5040.0	530	1072	12	12	18	1009	12
48W	–	5040.3	531	1072	–	24	30	1009	24
48Y	111.15	5061.6	602	1072	36	36	42	1135	30
48Z	–	5061.9	603	1072	–	21	27	1135	15
49X	111.20	–	–	1073	12	–	–	1010	12
49Y	111.25	5062.2	604	1073	36	36	42	1136	30
49Z	–	5062.5	605	1073	–	21	27	1136	15
50X	111.30	5040.6	532	1074	12	12	18	1011	12
50W	–	5040.9	533	1074	–	24	30	1011	24
50Y	111.35	5062.8	606	1074	36	36	42	1137	30
50Z	–	5063.1	607	1074	–	21	27	1137	15
51X	111.40	–	–	1075	12	–	–	1012	12
51Y	111.45	5063.4	608	1075	36	36	42	1138	30
51Z	–	5063.7	609	1075	–	21	27	1138	15
52X	111.50	5041.2	534	1076	12	12	18	1013	12
52W	–	5041.5	535	1076	–	24	30	1013	24
52Y	111.55	5064.0	610	1076	36	36	42	1139	30
52Z	–	5064.3	611	1076	–	21	27	1139	15

Table 1-2. Frequencies and Code Pulses for DME Channels (53 to 68)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
53X	111.60	–	–	1077	12	–	–	1014	12
53Y	111.65	5064.5	612	1077	36	36	42	1140	30
53Z	–	5064.9	613	1077	–	21	27	1140	15
54X	111.70	5041.8	536	1078	12	12	18	1015	12
54W	–	5042.1	537	1078	–	24	30	1015	24
54Y	111.75	5065.2	614	1078	36	36	42	1141	30
54Z	–	5065.5	615	1078	–	21	27	1141	15
55X	111.80	–	–	1079	12	–	–	1016	12
55Y	111.85	5065.8	616	1079	36	36	42	1142	30
55Z	–	5066.1	617	1079	–	21	27	1142	15
56X	111.90	5042.4	538	1080	12	12	18	1017	12
56W	–	5042.7	539	1080	–	24	30	1017	24
56Y	111.95	5066.4	618	1080	36	36	42	1143	30
56Z	–	5066.7	619	1080	–	21	27	1143	15
57X	112.00	–	–	1081	12	–	–	1018	12
57Y	112.05	–	–	1081	36	–	–	1144	30
58X	112.10	–	–	1082	12	–	–	1019	12
58Y	112.15	–	–	1082	36	–	–	1145	30
59X	112.20	–	–	1083	12	–	–	1020	12
59Y	112.25	–	–	1083	36	–	–	1146	30
60X	–	–	–	1084	12	–	–	1021	12
60Y	–	–	–	1084	36	–	–	1147	30
61X	–	–	–	1085	12	–	–	1022	12
61Y	–	–	–	1085	36	–	–	1148	30
62X	–	–	–	1086	12	–	–	1023	12
62Y	–	–	–	1086	36	–	–	1149	30
63X	–	–	–	1087	12	–	–	1024	12
63Y	–	–	–	1087	36	–	–	1150	30
64X	–	–	–	1088	12	–	–	1151	12
64Y	–	–	–	1088	36	–	–	1025	30
65X	–	–	–	1089	12	–	–	1152	12
65Y	–	–	–	1089	36	–	–	1026	30
66X	–	–	–	1090	12	–	–	1153	12
66Y	–	–	–	1090	36	–	–	1027	30
67X	–	–	–	1091	12	–	–	1154	12
67Y	–	–	–	1091	36	–	–	1028	30
68X	–	–	–	1092	12	–	–	1155	12
68Y	–	–	–	1092	36	–	–	1029	30

Table 1-2. Frequencies and Code Pulses for DME Channels (69 to 85)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
69X	–	–	–	1093	12	–	–	1156	12
69Y	–	–	–	1093	36	–	–	1030	30
70X	112.30	–	–	1094	12	–	–	1157	12
70Y	112.35	–	–	1094	36	–	–	1031	30
71X	112.40	–	–	1095	12	–	–	1158	12
71Y	112.45	–	–	1095	36	–	–	1032	30
72X	112.50	–	–	1096	12	–	–	1159	12
72Y	112.55	–	–	1096	36	–	–	1033	30
73X	112.60	–	–	1097	12	–	–	1160	12
73Y	112.65	–	–	1097	36	–	–	1034	30
74X	112.70	–	–	1098	12	–	–	1161	12
74Y	112.75	–	–	1098	36	–	–	1035	30
75X	112.80	–	–	1099	12	–	–	1162	12
75Y	112.85	–	–	1099	36	–	–	1036	30
76X	112.90	–	–	1100	12	–	–	1163	12
76Y	112.95	–	–	1100	36	–	–	1037	30
77X	113.00	–	–	1101	12	–	–	1164	12
77Y	113.05	–	–	1101	36	–	–	1038	30
78Y	113.10	–	–	1102	12	–	–	1165	12
78Y	113.15	–	–	1102	36	–	–	1039	30
79X	113.20	–	–	1103	12	–	–	1166	12
79Y	113.25	–	–	1103	36	–	–	1040	30
80X	113.30	–	–	1104	12	–	–	1167	12
80Y	113.35	5067.0	620	1104	36	36	42	1041	30
80Z	–	5067.3	621	1104	–	21	27	1041	15
81X	113.40	–	–	1105	12	–	–	1168	12
81Y	113.45	5067.6	622	1105	36	36	42	1042	30
81Z	–	5067.9	623	1105	–	21	27	1042	15
82X	113.50	–	–	1106	12	–	–	1169	12
82Y	113.55	5068.2	624	1106	36	36	42	1043	30
82Z	–	5068.5	625	1106	–	21	27	1043	15
83X	113.60	–	–	1107	12	–	–	1170	12
83Y	113.65	5068.8	626	1107	36	36	42	1044	30
83Z	–	5069.1	627	1107	–	21	27	1044	15
84X	113.70	–	–	1108	12	–	–	1171	12
84Y	113.75	5069.4	628	1108	36	36	42	1045	30
84Z	–	5069.7	629	1108	–	21	27	1045	15
85X	113,80			1109	12	-	-	1172	12
85Y	113,85	5070.0		1109	36	36	42	1046	30
85Z	-	5071.3		1109	-	21	27	1046	15

Table 1-2. Frequencies and Code Pulses for DME Channels (86 to 99)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
86X	113.90	–	–	1110	12	–	–	1173	12
86Y	113.95	5070.6	632	1110	36	36	42	1047	30
86Z	–	5070.9	633	1110	–	21	27	1047	15
87X	114.00	–	–	1111	12	–	–	1174	12
87Y	114.05	5071.2	634	1111	36	36	42	1048	30
87Z	–	5071.5	635	1111	–	21	27	1048	15
88X	114.10	–	–	1112	12	–	–	1175	12
88Y	114.15	5071.8	636	1112	36	36	42	1049	30
88Z	–	5072.1	637	1112	–	21	27	1049	15
89X	114.20	–	–	1113	12	–	–	1176	12
89Y	114.25	5072.4	638	1113	36	36	42	1050	30
89Z	–	5072.7	639	1113	–	21	27	1050	15
90X	114.30	–	–	1114	12	–	–	1177	12
90Y	114.35	5073.0	640	1114	36	36	42	1051	30
90Z	–	5073.3	641	1114	–	21	27	1051	15
91X	114.40	–	–	1115	12	–	–	1178	12
91Y	114.45	5073.6	642	1115	36	36	42	1052	30
91Z	–	5073.9	643	1115	–	21	27	1052	15
92X	114.50	–	–	1116	12	–	–	1179	12
92Y	114.55	5074.2	644	1116	36	36	42	1053	30
92Z	–	5074.5	645	1116	–	21	27	1053	15
93X	114.60	–	–	1117	12	–	–	1180	12
93Y	114.65	5074.8	646	1117	36	36	42	1054	30
93Z	–	5075.1	647	1117	–	21	27	1054	15
94X	114.70	–	–	1118	12	–	–	1181	12
94Y	114.75	5075.4	648	1118	36	36	42	1055	30
94Z	–	5075.7	649	1118	–	21	27	1055	15
95X	114.80	–	–	1119	12	–	–	1182	12
95Y	114.85	5076.0	650	1119	36	36	42	1056	30
95Z	–	5076.3	651	1119	–	21	27	1056	15
96X	114.90	–	–	1120	12	–	–	1183	12
96Y	114.95	5076.6	652	1120	36	36	42	1057	30
96Z	–	5076.9	653	1120	–	21	27	1057	15
97X	115.00	–	–	1121	12	–	–	1184	12
97Y	115.05	5077.2	654	1121	36	36	42	1058	30
97Z	–	5077.5	655	1121	–	21	27	1058	15
98X	115.10	–	–	1122	12	–	–	1185	12
98Y	115.15	5077.8	656	1122	36	36	42	1059	30
98Z	–	5078.1	657	1122	–	21	27	1059	15
99X	115.20	–	–	1123	12	–	–	1186	12
99Y	115.25	5078.4	658	1123	36	36	42	1060	30
99Z	–	5078.7	659	1123	–	21	27	1060	15

Table 1-2. Frequencies and Code Pulses for DME Channels (100 to 113)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
100X	115.30	–	–	1124	12	–	–	1187	12
100Y	115.35	5079.0	660	1124	36	36	42	1061	30
100Z	–	5079.3	661	1124	–	21	27	1061	15
101X	115.40	–	–	1125	12	–	–	1188	12
101Y	115.45	5079.6	662	1125	36	36	42	1062	30
101Z	–	5079.9	663	1125	–	21	27	1062	15
102X	115.50	–	–	1126	12	–	–	1189	12
102Y	115.55	5080.2	664	1126	36	36	42	1063	30
102Z	–	5080.5	665	1126	–	21	27	1063	15
103X	115.60	–	–	1127	12	–	–	1190	12
103Y	115.65	5080.8	666	1127	36	36	42	1064	30
103Z	–	5081.1	667	1127	–	21	27	1064	15
104X	115.70	–	–	1128	12	–	–	1191	12
104Y	115.75	5081.4	668	1128	36	36	42	1065	30
104Z	–	5081.7	669	1128	–	21	27	1065	15
105X	115.80	–	–	1129	12	–	–	1192	12
105Y	115.85	5082.0	670	1129	36	36	42	1066	30
105Z	–	5082.3	671	1129	–	21	27	1066	15
106X	115.90	–	–	1130	12	–	–	1193	12
106Y	115.95	5082.6	672	1130	36	36	42	1067	30
106Z	–	5082.9	673	1130	–	21	27	1067	15
107X	116.00	–	–	1131	12	–	–	1194	12
107Y	116.05	5083.2	674	1131	36	36	42	1068	30
107Z	–	5083.5	675	1131	–	21	27	1068	15
108X	116.10	–	–	1132	12	–	–	1195	12
108Y	116.15	5083.8	676	1132	36	36	42	1069	30
108Z	–	5084.1	677	1132	–	21	27	1069	15
109X	116.20	–	–	1133	12	–	–	1196	12
109Y	116.25	5084.4	678	1133	36	36	42	1070	30
109Z	–	5084.7	679	1133	–	21	27	1070	15
110X	116.30	–	–	1134	12	–	–	1197	12
110Y	116.35	5085.0	680	1134	36	36	42	1071	30
110Z	–	5085.3	681	1134	–	21	27	1071	15
111X	116.40	–	–	1135	12	–	–	1198	12
111Y	116.45	5085.6	682	1135	36	36	42	1072	30
111Z	–	5085.9	683	1135	–	21	27	1072	15
112X	116.50	–	–	1136	12	–	–	1199	12
112Y	116.55	5086.2	684	1136	36	36	42	1073	30
112Z	–	5086.5	685	1136	–	21	27	1073	15
113X	116.60	–	–	1137	12	–	–	1200	12
113Y	116.65	5086.8	686	1137	36	36	42	1074	30
113Z	–	5087.1	687	1137	–	21	27	1074	15

Table 1-2. Frequencies and Code Pulses for DME Channels (114 to 126)

CHANNEL PAIRING				DME PARAMETERS					
				INTERROGATION				REPLY	
					Pulse Codes				
						DME/P			
DME Channel	VHF FREQ. MHz	MLS FREQ. MHz	MLS Channel	Frequency MHz	DME/N µs	IAM µs	FAM µs	Frequency MHz	Pulse Codes µs
114X	116.70	–	–	1138	12	–	–	1201	12
114Y	116.75	5087.4	688	1138	36	36	42	1075	30
114Z	–	5087.7	689	1138	–	21	27	1075	15
115X	116.80	–	–	1139	12	–	–	1202	12
115Y	116.85	5088.0	690	1139	36	36	42	1076	30
115Z	–	5088.3	691	1139	–	21	27	1076	15
116X	116.90	–	–	1140	12	–	–	1203	12
116Y	116.95	5088.6	692	1140	36	36	42	1077	30
116Z	–	5088.9	693	1140	–	21	27	1077	15
117X	117.00	–	–	1141	12	–	–	1204	12
117Y	117.05	5089.2	694	1141	36	36	42	1078	30
117Z	–	5089.5	695	1141	–	21	27	1078	15
118X	117.10	–	–	1142	12	–	–	1205	12
118Y	117.15	5089.8	696	1142	36	36	42	1079	30
118Z	–	5090.1	697	1142	–	21	27	1079	15
119X	117.20	–	–	1143	12	–	–	1206	12
119Y	117.25	5090.4	698	1143	36	36	42	1080	30
119Z	–	5090.7	699	1143	–	21	27	1080	15
120X	117.30	–	–	1144	12	–	–	1207	12
120Y	117.35	–	–	1144	36	–	–	1081	30
121X	117.40	–	–	1145	12	–	–	1208	12
121Y	117.45	–	–	1145	36	–	–	1082	30
122X	117.50	–	–	1146	12	–	–	1209	12
122Y	117.55	–	–	1146	36	–	–	1083	30
123X	117.60	–	–	1147	12	–	–	1210	12
123Y	117.65	–	–	1147	36	–	–	1084	30
124X	117.70	–	–	1148	12	–	–	1211	12
124Y	117.75	–	–	1148	36	–	–	1085	30
125X	117.80	–	–	1149	12	–	–	1212	12
125Y	117.85	–	–	1149	36	–	–	1086	30
126X	117.90	–	–	1150	12	–	–	1213	12
126Y	117.95	–	–	1150	36	–	–	1087	30

1.3 GENERAL FEATURES OF THE EQUIPMENT

1.3.1 Equipment Versions

The DME 415 and 435 are respectively the lower power and the higher power versions of a complete family of latest-generation equipment composed by:

- **Approach DME 415**: a 100 W solid-state DME can be installed also in co-location with ILS
- **En-route DME 435**: a 1 kW solid-state DME can be installed also in co-location with VOR or DVOR.

The two versions all feature a high commonality of modules and of principles of operation.

1.3.2 Main Feature of the Equipment

The main features of the equipment are:

- Compliant with the ICAO specifications in Annex 10, 5th ed. and Eurocae MPS Ed. 57, standard 1 as applicable.
- Compliant with EEC Directives for CE Marking (EMC and Safety)
- Housed in a single 19" cabinet
- Powerable both from mains and standard 48 V batteries, with a built-in battery charger as an option
- Fully dualized, (being composed of two transponders and two monitoring systems) but configurable also in the following versions:
  1) single TRX and single Monitor
  2) single TRX and dual Monitor
- Completely modular
- Accurate distance information: up to ±15 m
- Digitally controlled output pulse shape
- Microprocessor-controlled monitors and transponders
- Monitor-independent reply delay self-adjustment
- Automatically performed self-check and measurements, the results of which can be continuously displayed
- Automatically provided ICAO performance checks at programmable intervals and results storing/displaying/printing
- Capable of executing a resident diagnostic program to help the operator in fault location.
- Operable as a stand-alone unit, but conceived to be co-located with other navaids like ILS,VOR or DVOR
- Control by a Personal Computer (PC) at beacon site, which can be duplicated at remote site; the PC can also be a portable unit to be connected only when required for maintenance reasons
- Remote control is fully compatible with all the system 400 equipment and with previous versions of DME's (FSD-40/45)
- Able to be connected to both an RCSU-2040 (part of Thales: Remote Maintenance and Monitoring Configuration - RMMC) and the FRCM/NS Remote Control and Monitoring Network System, or new remote control MCS (Monitoring and Control System): highly versatile systems for interfacing and controlling different navaids facilities.

1.3.2.1 Engineering

- Accessibility: front door access is only required. Equipment can be wall-mounted.
- Modularity: all circuits are divided into functional modules.
- Interconnections: extensive use is made of printed board back panels, flat ribbon cables and semi-rigid coaxial cables.
- Identifications: all modules are easily recognizable by P/N and a two/three/four-letter code (e.g.: RX, TX, DPR, BCPS) permanently marked on easily readable surfaces. All modules, cables and connectors are marked and keyed to prevent incorrect connection.
- Cooling: no blowers are required to remove heat from the equipment. Use is made of extruded aluminum heat sinks.
- Printed boards: two - or multilayer printed boards with plated-through holes are used throughout the equipment. High frequency circuits are implemented in microstrip technique.
- RF shielding: all RF circuits are accurately shielded in casting boxes.
- Components: only high-quality components are used, in order to meet the reliability requirements.
- Corrosion: protection against corrosion and fungus is obtained by means of suitable materials, finishes and coatings.

1.3.2.2 Safety

- The equipment is designed to be intrinsically safe for the user. No dangerous voltages except mains are used.
- All modules or places, where a dangerous voltage may be accessible, are firmly protected by covers not removable without using tools and are clearly marked with warning readouts.
- Special protective circuits are built-in in order to ensure that any failure in the equipment does not cause further damage to other parts or components.

1.3.2.3 Installation

- Installation of DME 415-435 requires preparation of the site (i.e. shelter or equipment room, antenna support mast, cable layout, power and ground connections etc.- (see section 2 "INSTALLATION" and ANNEX A "DME ANTENNA SITING CRITERIA" in this manual).
- Installation of the equipment is simple and can be accomplished in few hours even by unskilled personnel with a minimum of tools. The equipment only requires a minimum of shelter room.
- Ground and flight tests may be performed with the assistance of Thales technicians if requested.

1.3.2.4 Operation

- The Operator's interface consists of a PC terminal connected to the equipment. The basic control of the equipment (on/off or changeover) is possible with local I/O front panel, however, even when the PC is not available,

Cabinet Part Number: 297.509.004

Cabinet Part Number: 297.509.007

Figure 1.4. DME 415 (same as DME 435) – Cabinet and PC, example of arrangement

1.4 BEACON COMPOSITION AND IDENTIFICATION

The DME 415/435 ground equipment, as shown in figure 1.4, is constructed by THALES Italia S.p.A Air Systems Division - Milan - Italy.
The DME versions are mounted in two cabinet's types shown in figure 1.4 to customer choice.

The related reference modules labels of the equipment DME415/435 are given in table 1-3.

Table 1-3. Composition of the Equipment

Dual Q.ty	Single Q.ty	Name	Ref. Label
1	1	Wired Cabinet (standard)	
		RF Path	
2	1	Duplexer	DPX
1	1	RF COAX Relay and PBA	KCX
1		Coax Dummy Load -100 W, 50 Ω	
1	1	External Filter Antenna KIT (optional)	
2+2	1+1	10 dB + 10 dB PAD (only for DME 435)	
		Interface System	
1	1	Associated Facility Interface	AFI
1	-	Dummy Interface	TAI
1	1	Modem 1 Party Line (LGM 1200) (option)	MDM
1	1	Modem 2 LGM 28,8 D1 (option)	MDM
		Transponder and Monitor	
2	1	Power Supply (DC/DC converter; + 5V, ± 15V)	PWS
2	1	Monitor	MON
2	1	Receiver	RX
2	1	Digital Processor	DPR
2	1	Digital Modulator	DMD
2	1	Transmitter 100 Wp (also driver for DME 435)	TX 100
2	1	Transmitter Amplifier 1kWp (only for DME 435)	TKW
		Local I/O	
1	1	Local Control Status Unit composed of: - Control and Status Board - Indication and Controls	LCSU CSB INC
		Power Supply	
1	1	Battery Charger and Power Supply subrack (option)	BCPS
2	1	AC/DC 600W Module (option)	AC-DC
1	1	Terminal bar- 48Vdc (option)	-
1	1	Batteries supervisor only for BCPS Frako (option)	-

Table 1-4 gives the composition of the user interface for the local and remote sites.

The accompanying material supplied with the beacon is listed in table 1-5.

Table 1-4. User Interface Composition (option)

Q.TY	NAME	REF.
	LOCAL SITE:	
1	PC Requirements- Lap/Palm top	-
	Processor Pentium 90 or better, (for use with MCS monitoring: INTELP4, AMDK7 - Clock speed 2 GHz or better)	
	Operating system IBM/AT compatible suited to run 95, 98, 2000XP or NT version (for MCS: WIN/NT, W2K, Linux)	
	Main memory 16 MB RAM min. (256/512 MB min for MCS)	
	VGA adapter color display: 32MB	
	HDD: 120 MB min. Hard Disk, min. 20MB free space on HDD (20GB/2x20GB min for MCS)	
	3.5” Floppy Disk FDD (1.44 MB),	
	CDROM drive,	
	Control via mouse or comparable	
	Serial interface connectors	
1	Printer	-
1	Status Indicator (repeater of the main indication beacon status)	SI 446
	REMOTE SITE:	
1	Remote Control Status Indicator (composition: see RCSI or RCSE or MCS technical manual)	RCSI 446
1	PC Requirements- Lap/Palm top: *as Local site*	-
1	Keyboard (PC desk version)	-
1	Printer	-
1	Status Indicator (repeater of the main indication beacon status)	SI 446

Table 1-5. Material Supplied

Name	NOTE
STANDARD	
PC interconnection cable	
OPTIONAL	
Mains Cable	
Grounding Cable	
Battery Cable (+)	
Battery Cable (-)	
Auxiliary INPUT Cable (Parallel I/O)	
Auxiliary OUTPUT Cable (Parallel I/O)	
Cable for external modem	
Interface Facility Cable (for AFI interface module)	
Serial data Cable (D-VOR/ILS)	
Telephone Cable	
Antenna coax cable	
Antenna monitors probe coax cables	
Obstruction light cable	
Modem adapter Kit	
Tool bag	
Extender board - Video Digital (see Vol. 2 Section 1)	
Extender board - RF (see Vol. 2 Section 1)	

Figure 1.4 is a typical example of arrangement of the equipment and shows the front of a door. The local indication and control panel is flush-mounted in the front door. It contains an RS232 connector for interfacing with an intelligent terminal (PC).

Figures from 1.5 to 1.9 show the location of the parts and modules of the equipment valid for both cabinet type.

Figure 1.8 shows the photos of DME 435 with front door closed and rear of equipment.

Each equipment module and part code number is indicated on Vol. 2: List of Components in this Technical Manual.

1.5 PHYSICAL AND MECHANICAL General Description

The standard (full dual) configuration of the DME 415-435 equipment is composed of two transponders, a dual monitor system a RF path system, a Panel Control and a coaxial transfer relay unit. The parts of the equipment are housed in a single 19" standard cabinet (cabinet's types: view in fig. 1.4).
The cabinet, which is made of molded and welded steel sheet, can accommodate four 19" assembled carriers (subracks). Plug-in units are used as double or single Euroform printed circuit boards, with dimensions of 233.4 x 220 [mm] or 100 x 220 [mm].

The cabinet, which has a perforated metal plate on top and bottom, is self-ventilated (no forced ventilation necessary).

NOTE: Do not block or seal the holes for the cooling air supply.

The front part of the cabinet is protected by a hinged door complete of locking mechanism and the Control front Panel (Local I/O).
The top end of the cabinet provides four threaded holes used to screw in the eyebolts when the beacon is to be lifted.
The RF output connector to the antenna and the RF antenna monitor input connectors are located on top of the cabinet. The RF Duplexer modules are mounted inside of the "RF Amplifier/DPX" subrack on the upper part of the cabinet. The 1 kWp RF amplifier modules are mounted on the lateral sides of the same subrack, while the interface connections (e.g. modem, Associated Facility) are located on the bottom.

The RF components of the modules are in shielded casting boxes.
The Transponder/Monitor 1 and 2 subracks are located in middle part of the cabinet.

The AC/DC power supply units are located on the bottom of the cabinet. The BCPS subrack (optional) comprises a terminal bar for mains and 48Vdc input.

Local I/O components (LCSU consisting of CSB module and INC module) are fastened to the hinged front door in the upper part. The CSB board of the LCSU unit, combined with the INC module, is mounted on the rear of the front door.
The local control front panel of the INC module part of LCSU unit is equipped with indicators and commands:

- the indicators, for immediate check of beacon functioning and
- the main commands, for beacon control (acquisition and release of control, powering on/off, transponder change over) without having to use the local PC.

The I/O panel with the external interconnection connectors is located in the top end of the cabinet (figure 1.9)
The front view of the DME 415 and DME 435 equipments, with the open door, is shown in figures 1.5 and 1.6. These figures show the positions of all the modules, which compose the equipment in the typical full (or dual) version.
For special purposes, the equipment can be supplied in a single, non-redundant version, where very high system availability is not mandatory.

Figure 1.7 shows the typical single version of the DME 435 equipment. The single version of the DME 415 is the same as the DME 435 in which the final RF amplifier "TKW" module is removed.

The DME 415-435, dual or full version, is composed of a wired cabinet housing the following hardware parts and modules:

- ❑ Local I/O
  - Local Control and Status Unit (LCSU) composed of
    - Control Status Board module (CSB)
    - Indication and Control module (INC)
  - I/O Panel (on top of the cabinet)

- RF Amplifier/DPX subrack unit consisting of:
  - Final Amplifier module (DME 435 only) (TKW)
  - Duplexer module (DPX)
  - Coaxial Relay and driver PBA (KCX and KCXM)
  - Coax Dummy Load
  - Association Facility Interface module (AFI)
  - Interface (TAI dummy)
  - Modem modules (optional) (MDM) (including adapter kit : RS232 to TTL converter)
  - Backpanel of the TKW (BPKW)
- Transponder/Monitor 1 and 2 subrack units, both consisting of:
  - DC/DC Power Supply module (PWS)
  - Monitor/Interrogator module (MON)
  - Receiver module (RX)
  - Processor module (DPR)
  - Modulator module (DMD)
  - Transmitter (driver for DME 435) (TX100)
  - Backpanel of the transponder/monitor (BPT)
- Mains Power unit
  - Battery Charger Power Supply subrack (BCPS)
  - AC/DC module (AC/DC)
  - Terminal Bar

All check and maintenance operations can be performed on the front of the equipment, upon opening the cabinet front door.

Each subrack can be pulled out after unscrewing the fixing bolts (sliding are not provided).

All main modules (except the front ones of the LCSU unit) are plug-in types. Each module slides can be easily pulled out by using proper handles placed on the front.

The bottom of the cabinet provides the entrance of the mains and 48 V dc cables through bush fair-leads (see Section 2: INSTALLATION).

Connectors of the I/O panel mounted on the upper side of the cabinet provide the connection with the external interface cables.

Each subrack has a backpanel on which connectors of the plug-in modules and the subrack interconnection are mounted. All cable connectors (signals and mains) of subrack interconnection are within reach from the front.

Interconnection with backpanels is provided by flat ribbon cables for low level signals and by cables for 48Vdc supply. Cables lay on the inside of the cabinet behind the subracks.

A 4-way (transfer type) RF coaxial relay is mounted on a support fixed on the upper side of the cabinet by means of bolts (Figure 1.9), which can be unscrewed before inspecting the relay. The relay RF output is directly connected to the antenna connector. The relay is power supplied through a specific interface circuit fixed on the same coaxial relay.

The RF connection semi-rigid coaxial cables lay on the inside of the cabinet behind the subracks.

The semi-rigid coaxial cables end with floating coaxial connectors used for the sliding modules that also comprise the RF circuits. The floating coaxial connectors are mounted on a reinforcement metal plate fixed on the back of the back panels.

The coaxial cables used for the output RF power provide the minimum distance and end with type "N" coaxial connectors.

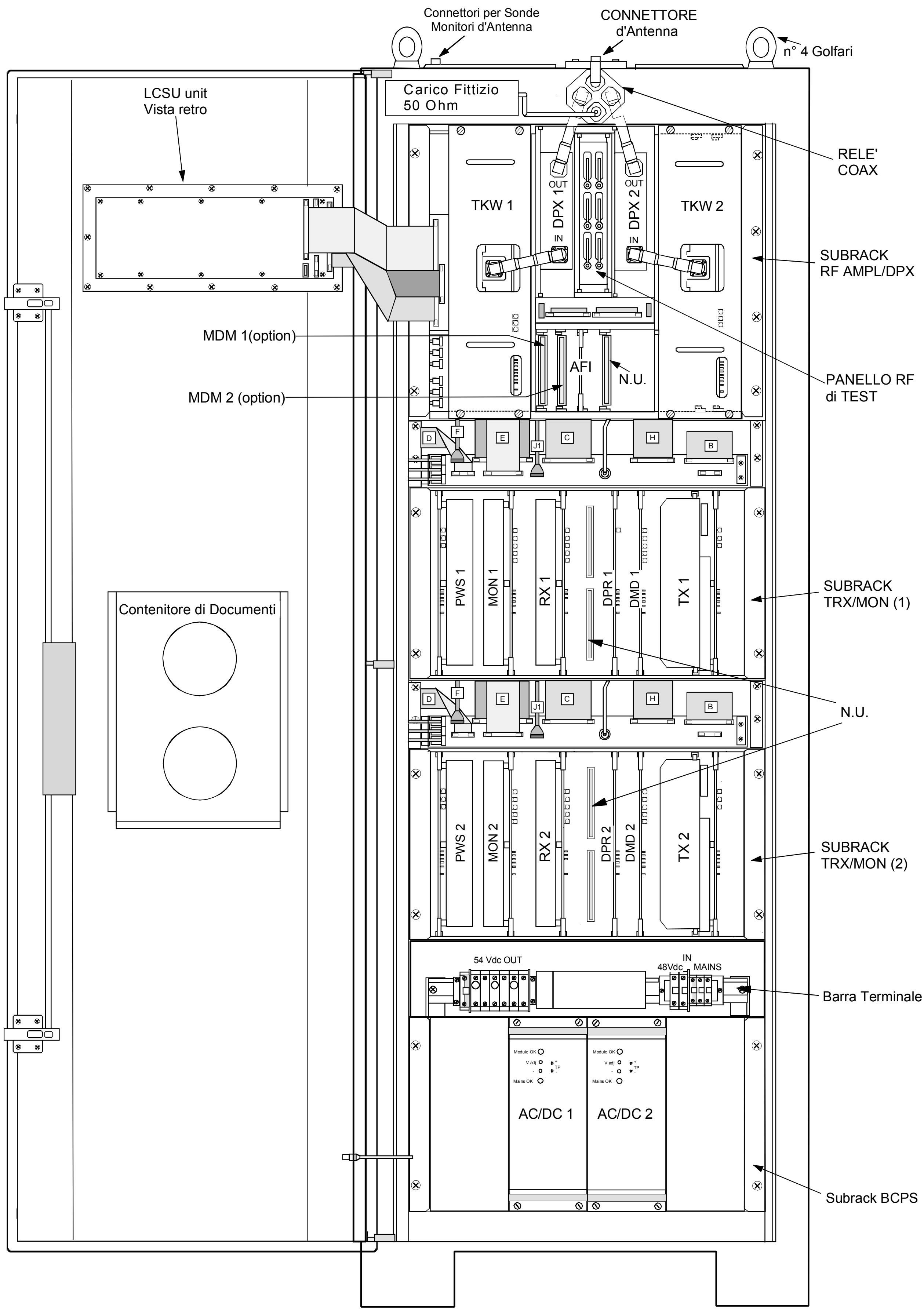


Figure 1.5. DME 435 – Front view with anterior door opened – Full Dual version

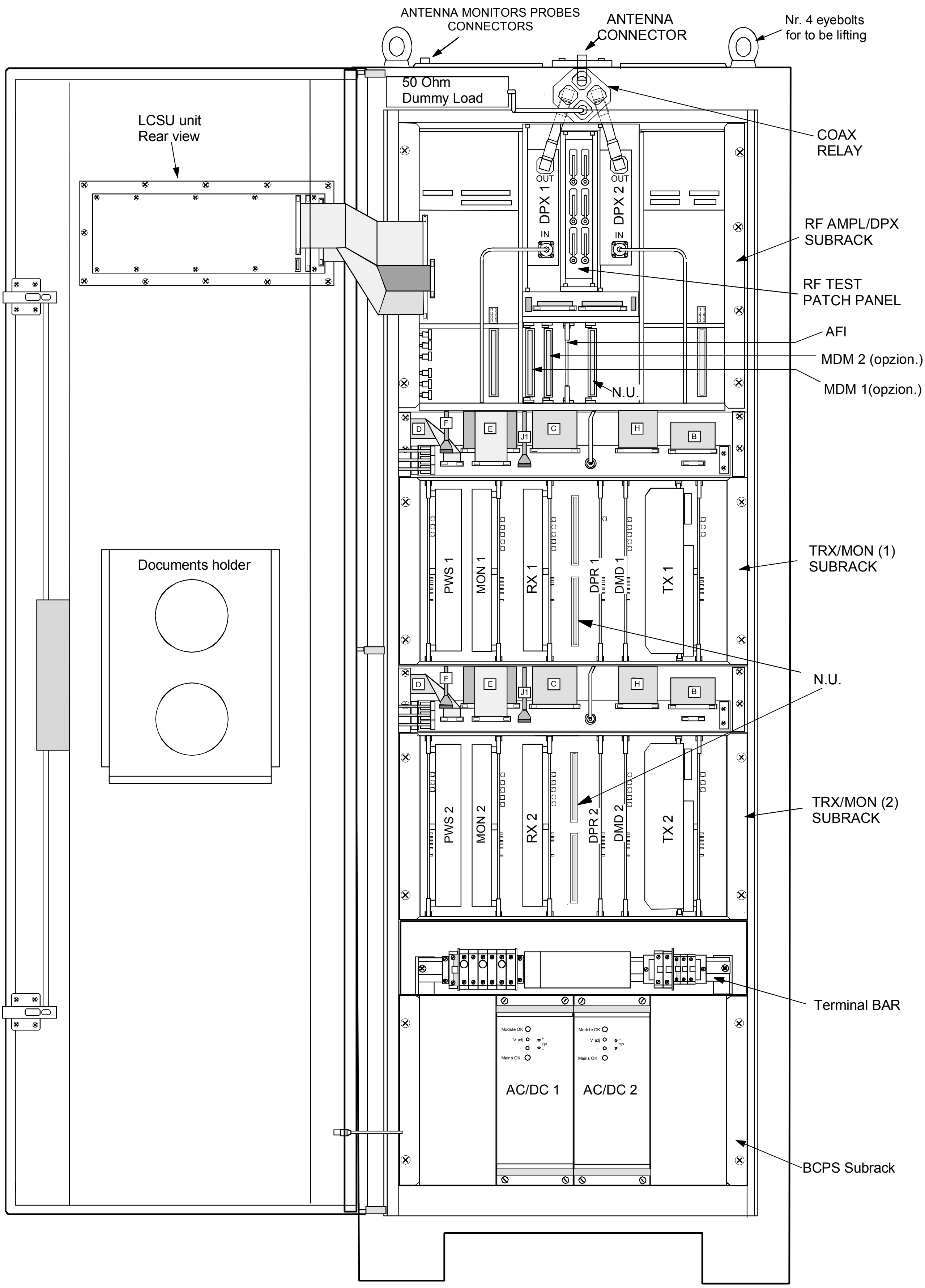


Figure 1.6. DME 415 – Front view with anterior door opened – Full Dual version

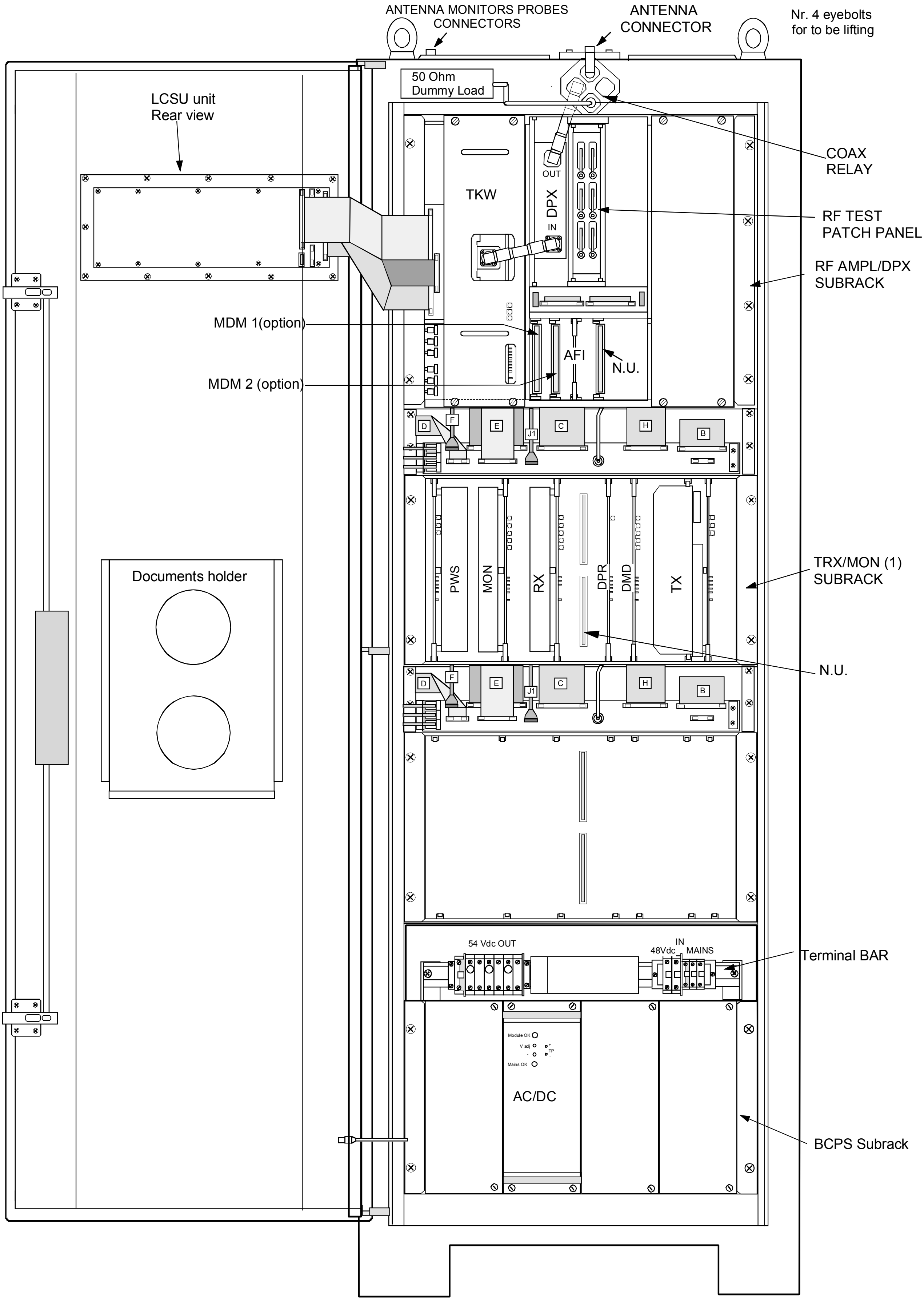


Figure 1.7. DME 435 Single version – Front view with anterior door opened

Figure 1.8. DME 435 – Rear side view of the cabinet

NOTE: Rear view valid for both cabinets type

NOTE: Top end valid for both cabinets type

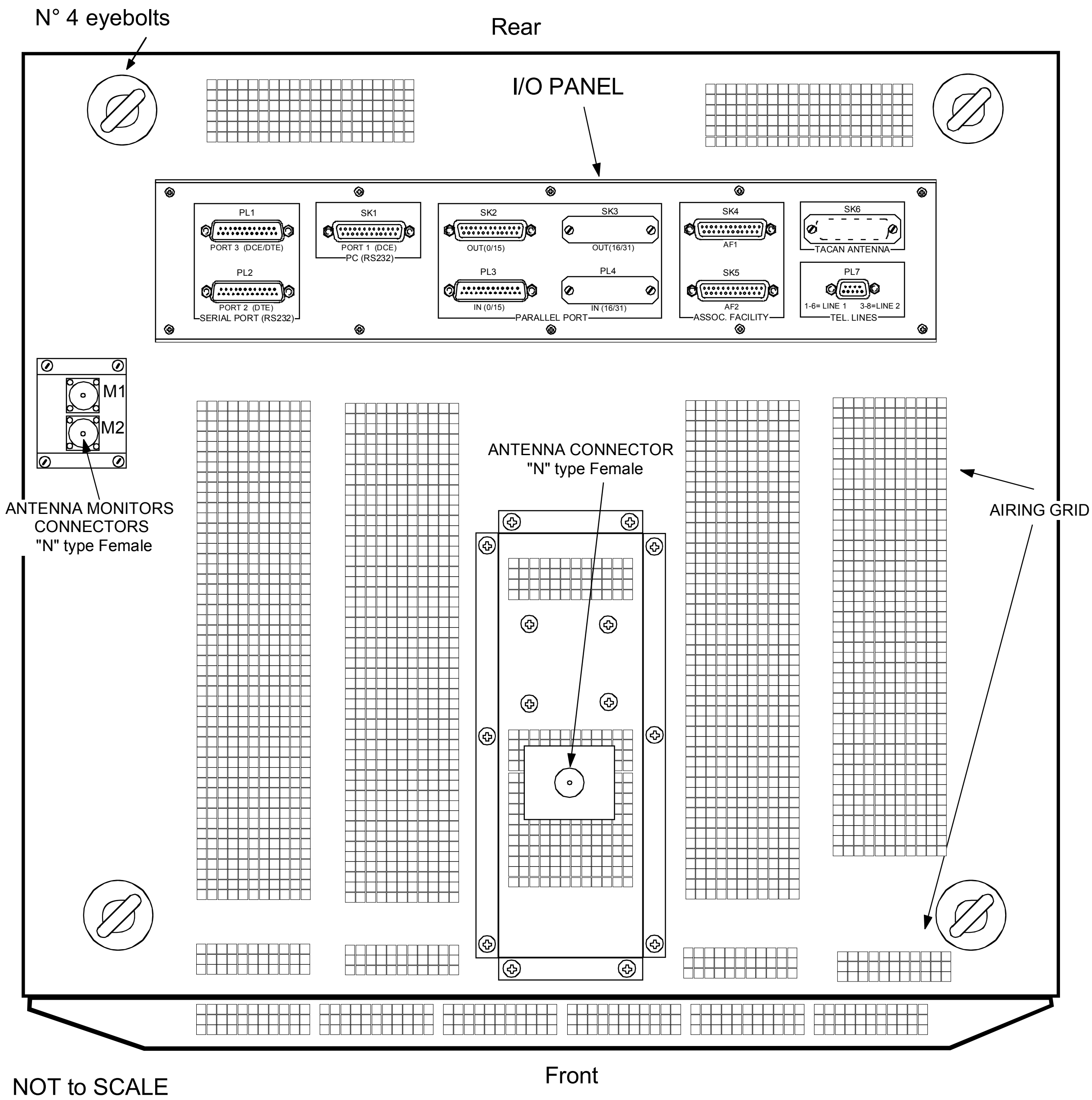


Figure 1.9. DME 415/435 – Top view

1.6 EQUIPMENT FUNCTIONAL DESCRIPTION

1.6.1 General Overview

The DME 415/435 system consists of hardware based on RF and video PBA, and of software that largely controls the hardware. In order to explain these functions, the description is divided in following main parts as by composition of the equipment (see also the simplified general block schematic with the main RF signals on fig 1.10.

The system is subdivided into the following units (dual or single version):

- Transponder (RX, DPR, DMD, TX-100, PWS)
- Transmitter Amplifier 1kWp (TKW) (only for DME 435)
- RF path – Duplexer and Coax. Relay (DPX, KCX, MKCX and TAI dummy)
- Monitor (MON)
- Local I/O (LCSU)
- Associated Facility Interface (AFI)
- AC/DC Power supply (BCPS)
- Antenna
- Modem (optional)
- Remote Control Indication (RCSI/RCSE or MCS)

Transmitter and monitor are controlled by their own individual microprocessors. Both communicate with the LCSU, controlled by its own microprocessor.

The transponder processor performs the following main tasks:

- General management of the transponder
- Digital and video processing
- Control/adjustment of main delay
- Control/adjustment of modulation for peak power and pulse shape

The monitor processor performs the following main tasks:

- General management of the monitor
- RF signal generation of interrogation pair for executive monitoring
- Evaluation of the transponder reply signals and receiver sensitivity (in Antenna and Dummy load)
- Execution of appropriate actions in case of fault detection (station changeover or shutdown)
- Ensuring of its own performance independent of environmental conditions and component aging (selfcheck)

The software packages (i.e., transponder SW, monitor SW, LCSU SW, PC WIN Supervisor, WIN ADRACS or MCS and WIN EQUIPMENT MANAGER) looks after and supports the most important tasks as follows:

- Startup (alignment and calibration of the set up)
- Modulation and transmitter control
- Signal generation
- Monitoring the output signal of the transponder
- Support in system repair and maintenance
- Operation of the system (local/remote)

The Local I/O (LCSU) processor performs the following main tasks:

- Communication via serial line RS232 with the monitor(s) and via serial line RS485 with transponders
- Beacon-operator interface via Personal Computer
- Basic beacon-operator interface via the Control Panel front door
- Check of the settings of equipment
- Connection to one or more remote control centers through switched or dedicated telephone lines
- Communication via modem with remote monitoring and site control
- History management

The Duplexer and RF path performs the following main tasks:

- Exchanges the RF path of the main transponder and of the stand-by transponder on the antenna and on the internal dummy load
- Coupling signal for monitoring interrogation
- Coupling signal for Pilot pulse
- Manual RF test with patch panel

1.6.2 DME 415/435 System Functional Description

The beacon comprises the following main parts:

- I/O system (LCSU, RCSI/RCSE or MCS, SI, PC, MDM);
- Transponder (RX, DPR, DMD, TX100, PWS);
- 1kWp Amplifier (TKW only DME435)
- RF path (DPX, Patch-panel);
- Monitoring (MON);
- Interface (AFI) and (TAI dummy);
- AC/DC power supply (BCPS).
- DME Antenna

The beacon can also be configured as single transponder either with one or two monitor(s).

The simplified functional block diagram of the dual configuration is shown in figure 1.10.

The simplified functional block diagram of the main RF signal path is shown in figure 1.11

A coaxial transfer switch (controlled by Monitors) is used to the transponder(s) either with the antenna line (main transponder) or with the internal dummy load (stand-by transponder) (see figure 1.10).
The antenna probes are used to monitoring the reply RF signals (figures 1.10 and 1.11)

Figures 1.12 and 1.13 are simplified functional block diagrams of the I/O and power supply systems respectively.

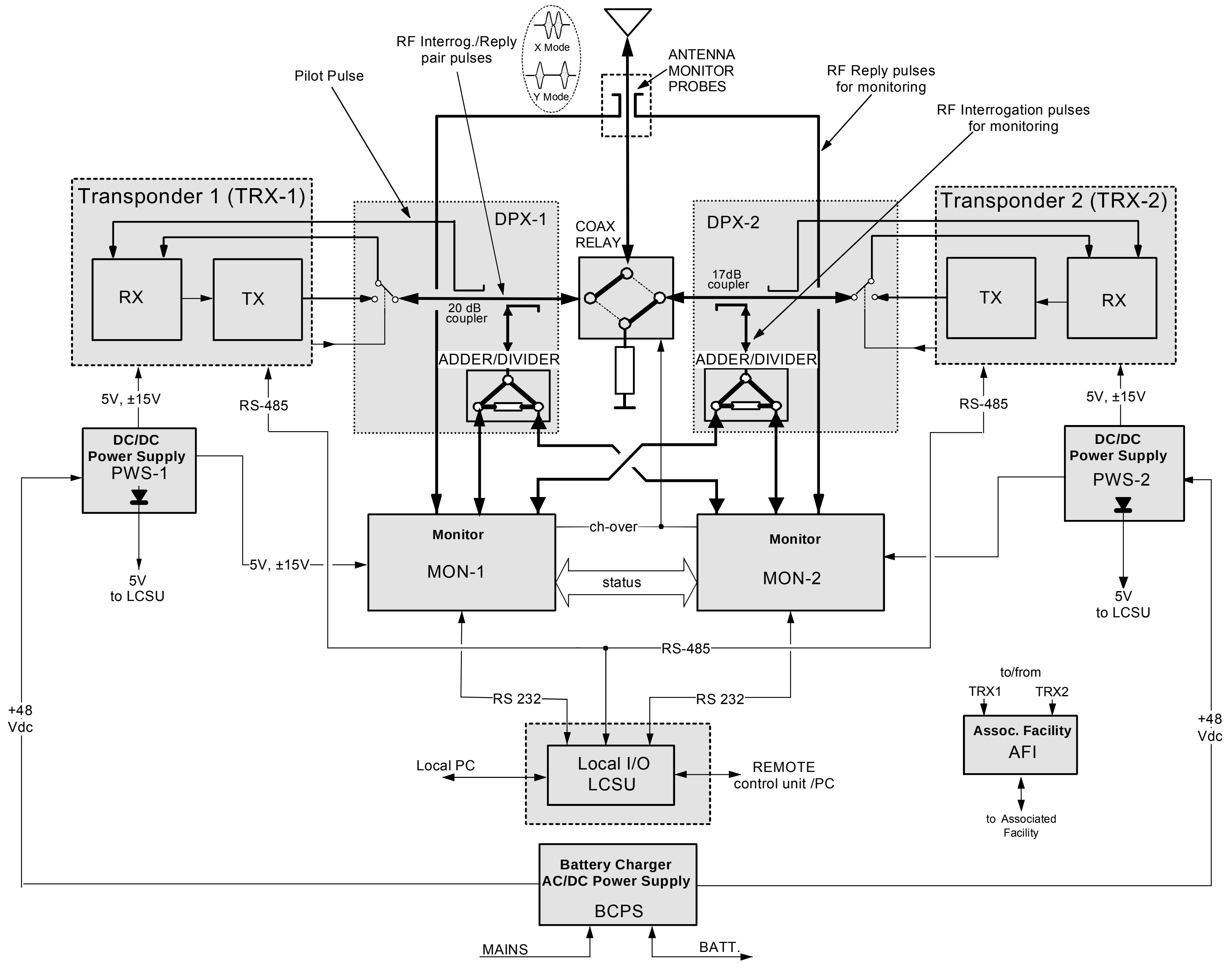


Figure 1.10. DME 415/435 – Simplified general block diagram

MONITOR SWITCHES POSITION

	SWITCH				
	S1	S2	S3	S4	S5
Interrog. for CALIB.	B	X	B	A	X
Interrog. to RX1/2	A	A/B	B	A	X
REPLY from TX1/2	B	A/B	A	X	X
ANTENNA Monit. PROBE	X	X	X	X	B
DIAGNOSTIC	X	X	X	B	A

INTERCONNECTING COAX CABLES

W1=Antenna (Ext)
W2=Antenna Probes (Ext)
W3=TX to DPX
W3a=TKW to DPX (DME435)
W3b=TX to TKW (DME435)
W4=RX to TX
W5a=DPX to RX via Patch Panel
W5b=RX to DPX via Patch Panel

INTERCONNECTING COAX CABLES

W6=DPX to KCX
W7a=RX test via Patch Panel
W7b=RX test via Patch Panel
W8a=MON Interr/Reply via Patch Panel
W8b=MON Interr/Reply via Patch Panel
W9=MON Interr/Reply (Cross interconnecting)
W10=Antenna Probes

PLUG-IN Type COAX CONNECTOR Module REF POSITION
1, 2, 3, 4 = DPX
1, 2, 3 = RX, MON
1, 2, = TX

DME 415/435

NOTE: 10 dB Attenuators used when TKW is present

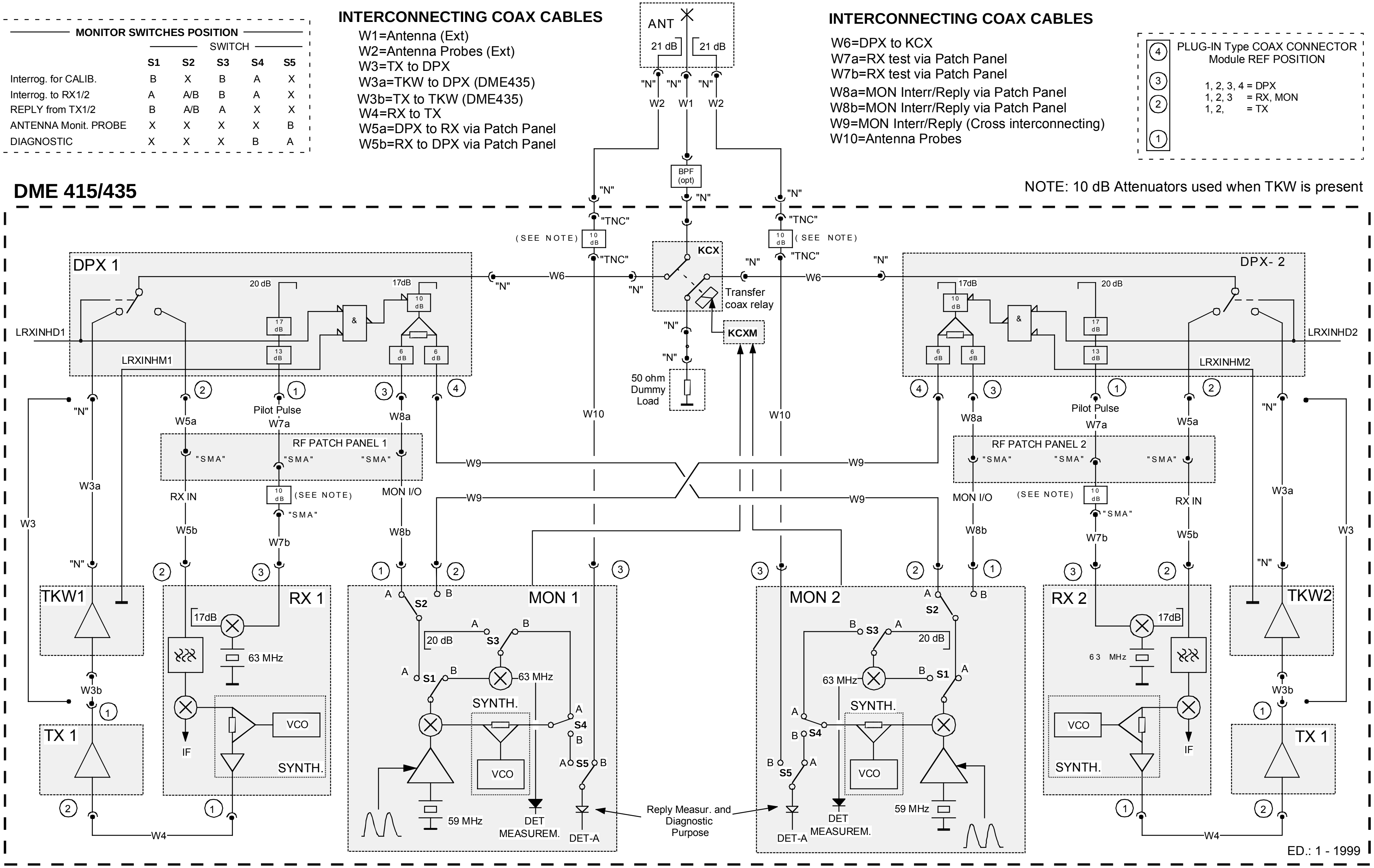


Figure 1.11. DME 415/435 – Main RF path signals - General simplified block diagram

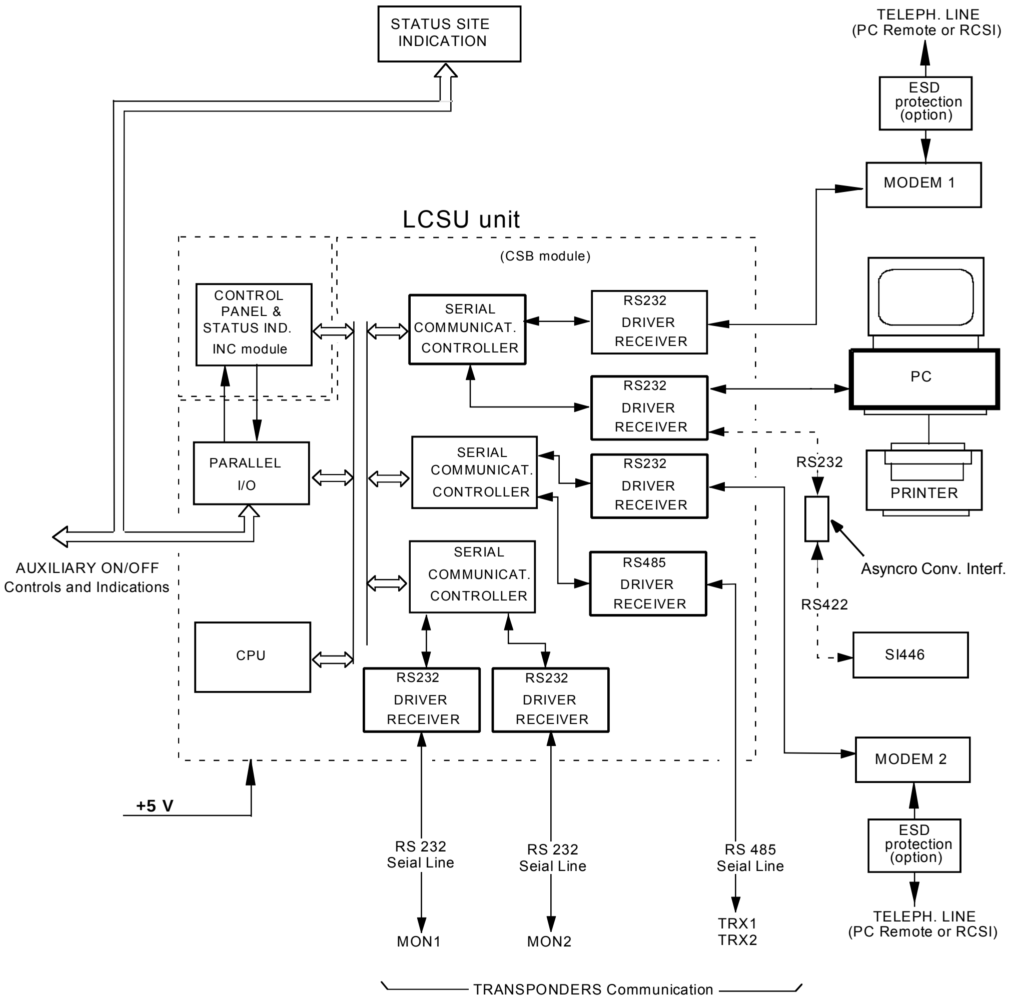


Figure 1.12. DME 415/435 – Local I/O system general block diagram

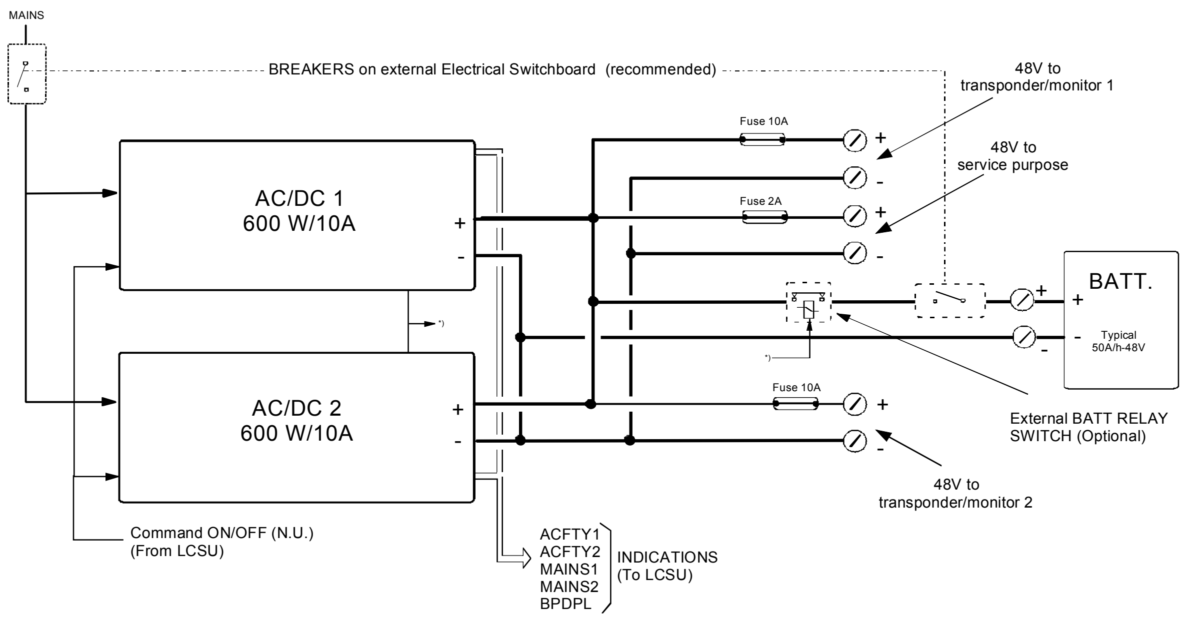


Figure 1.13. DME 415/435 – AC/DC Power Supply system & Battery Charge - Block diagram

1.6.3 I/O SYSTEM - Functional description

Consist of the Local and Remote Control & Maintenance System.

The I/O system is totally modular; it is able to meet any type of requirement that may arise in an installation.

Main features of the System are:

- Control/monitoring of the equipment by means of a standard Personal Computer, and/or Remote Control & Status Indicator and/or a Status Indicator of the beacon main indication.
- Control and monitoring of the beacon and its associated equipment (only on customer request), if any (e.g. VOR/ILS), by using a Personal Computer.
- Possibility to control, monitor and maintain the equipment station by using the public switched network or dedicated telephone lines

It is composed by the following main parts:

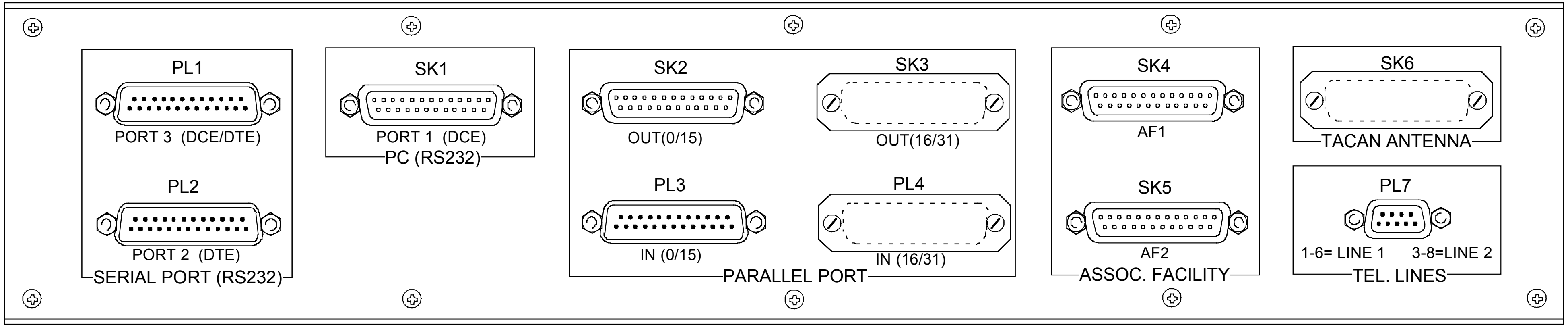
- Local Control & Status Unit "LCSU" housed inside the equipment, consisting of the Control Status Board module (CSB), the Indication and Control module (INC) and I/O panel
- Remote Control & Status Indicator "RCSI 446, RCSE 443 or MCS" (optional).
- Status Indicator "SI 446" (optional).
- standard Personal Computer IBM compatible (optional).
- Modem (optional).

1.6.3.1 I/O Local site

At the local site, the beacon-operator interface consists of:

- Module INC (LCSU) control and indication front panel;
- Personal Computer (optional), which allows the operator to completely control and monitor the beacon;
- Status Indicator SI446 (optional), which may be installed in the equipment control room or control tower.
  It is handled by the LCSU unit, which also controls the communication with other equipment and/or device(s), through RS-232C serial interface ports or through modem and telephone lines.
- The I/O Panel (figure 1.14) located on the top end of the cabinet is complete with a set of interconnection connectors interface the external equipment or devices.

A typical configuration of the local site set-up is shown in figure 1.15.



PL1 = UNAVAILABLE if MDM 2 IS USED
PL2 = UNAVAILABLE if MDM 1 IS USED

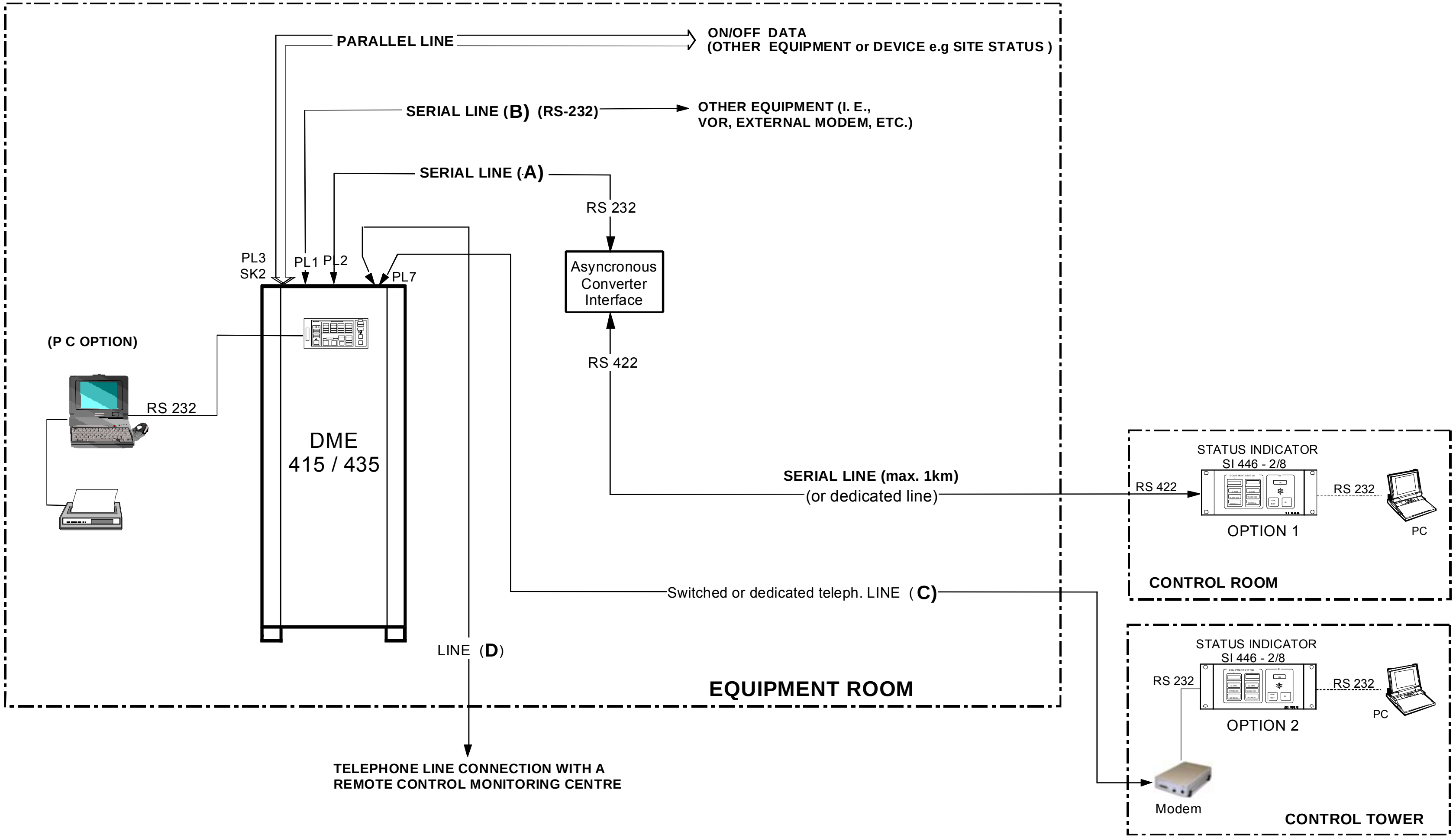
SK1 = PC connection UNAVAILABLE if PC connector on FRONT PANEL is USED

SK2 = N° 16 AUXILIARY ON/OFF OUT SIGNALS (standard)
PL3 = N° 16 AUXILIARY ON/OFF IN SIGNALS (standard) (e.g. possible Site Status Indication)
SK3 = N° 16 AUXILIARY ON/OFF OUT SIGNALS (optional)
PL4 = N° 16 AUXILIARY ON/OFF IN SIGNALS (optional)

SK4 = Associated Facility EQPT 1
SK5 = Associated Facility EQPT 2

SK6 = N.U.
PL7 = N° 2 Telephon Line Internal MODEM connected

Figure 1.14. I/O Panel



NOTE 1: **C&D** line UNAVAILABLE if **A&B** line ARE USED and viceversa

NOTE 2: On OPTION 1&2
possible use of
RCSI 446-2/8 Remote Control

Figure 1.15. Local site set up – Typical configuration

1-33

1.6.3.2 LOCAL CONTROL & STATUS UNIT (LCSU)

The LCSU unit is the local main unit connecting the equipment to the remote control system. It also handles the communication with remote monitoring and control sites, which takes place also through modem and telephone line(s). It is mounted into the equipment cabinet but it is a functionally separate block. The LCSU is powered by the service voltages of the DME equipment.

Its main functions:

- sends basic controls to the equipment;
- displays the status of the equipment ;
- interfaces modem(s) connecting the equipment with remote units or PCs;
- interfaces the local PC to control-monitor the equipment and to perform maintenance operations at the site;
- interfaces the co-located equipment (only on customer request).
- manages the two modems (optional, placed inside the equipment) that operate with dedicated or switched lines up to 28.800 bps.

LCSU consists of the following parts (figure 1.16):

- the Control & Status Board (CSB 186 module) that carries the unit management software.
- the control panel and the status indicator (INC module) used to forward the basic controls and to display the equipment operating status.

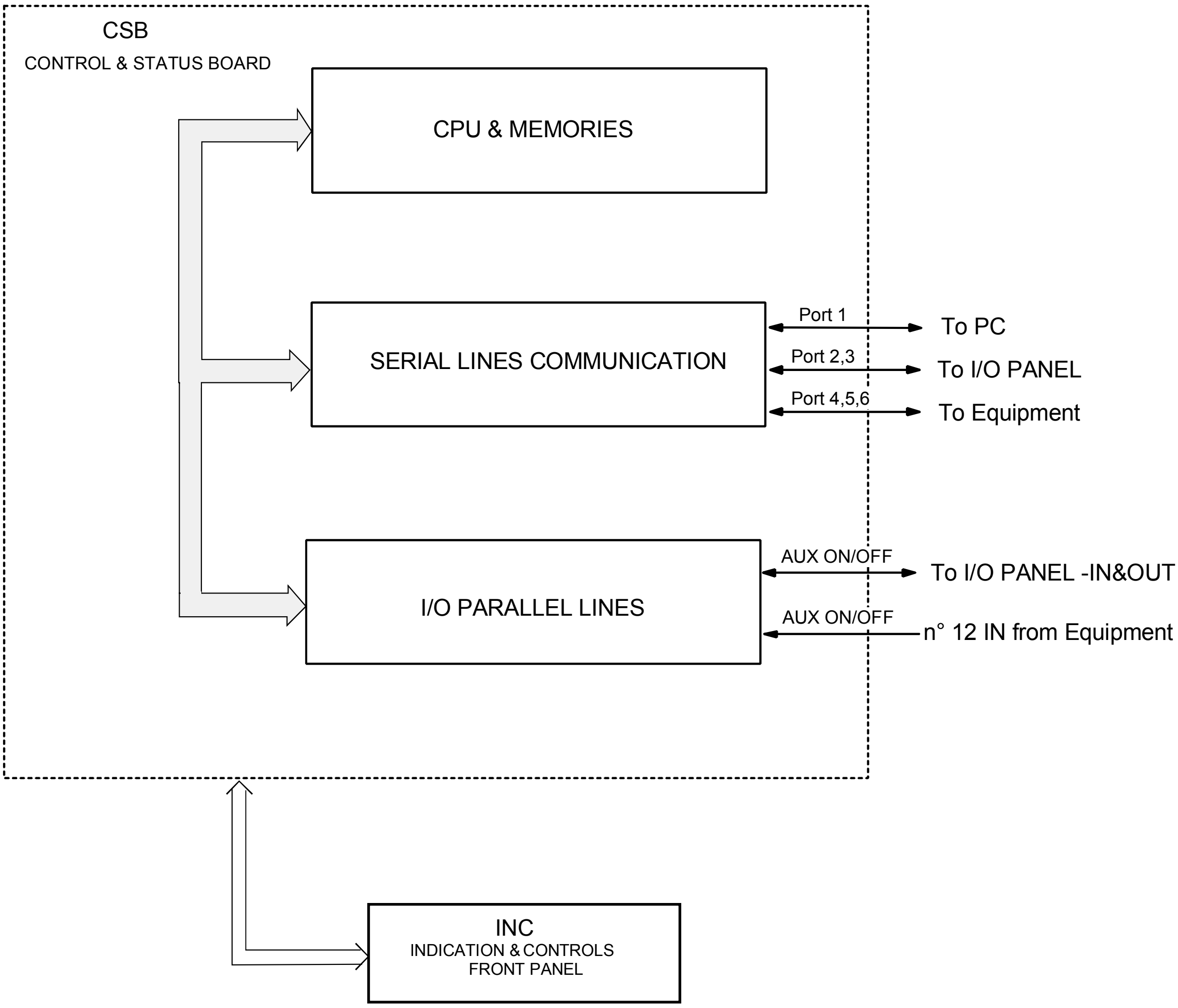


Figure 1.16. LCSU - Simplified Block Diagram

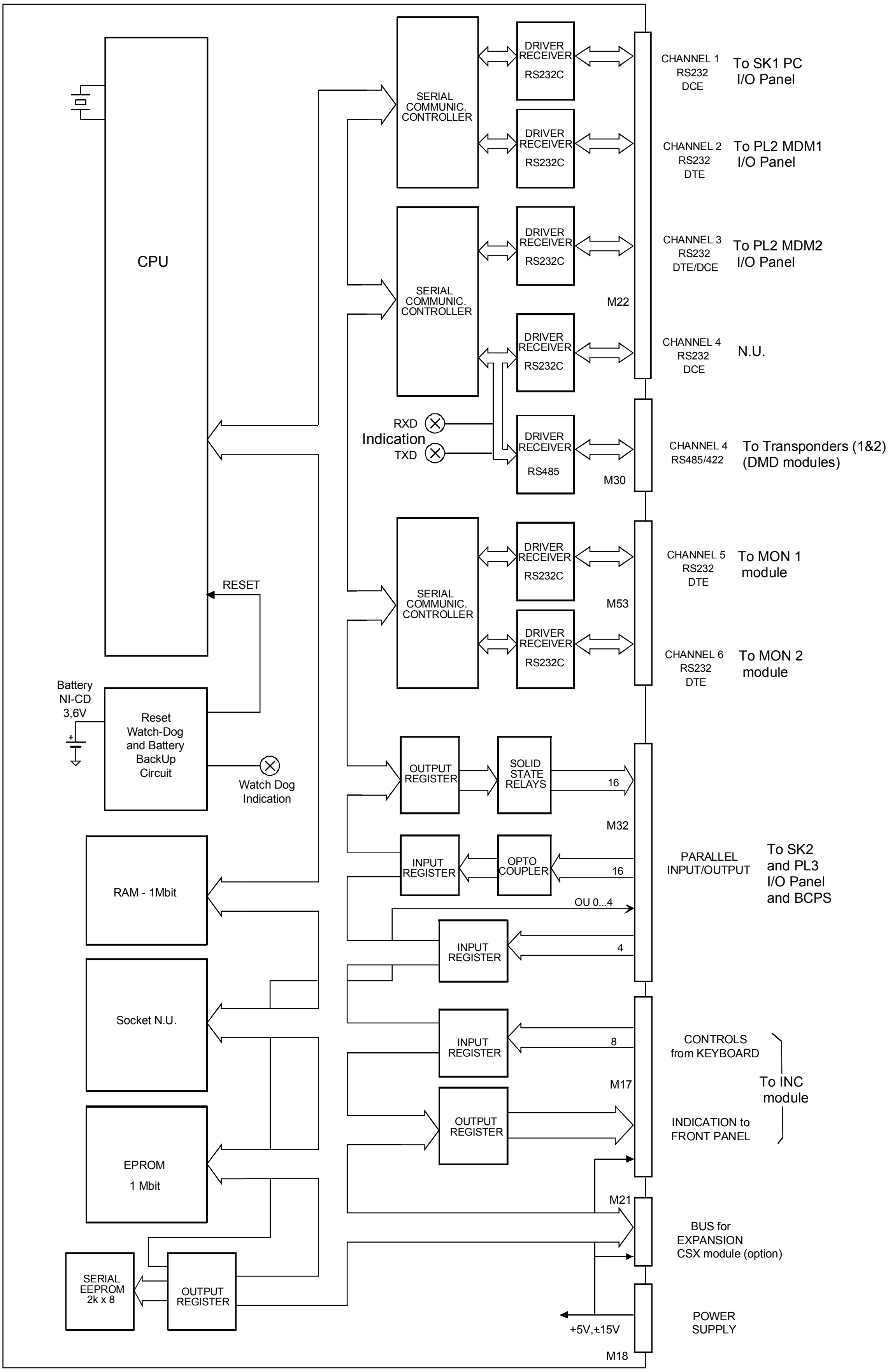


Figure 1.17. CSB module – Simplified Block Diagram

1.6.3.2.1 CONTROL AND STATUS BOARD - CSB module – Functional description

The main functions of the CSB module (see figures 1.18 block diagram) are as follows:

- management of interfacing between the equipment and remote system;
- up-dating of the remote site unit;
- communication with the monitors on the RS-232C serial links;
- communication with the transponder equipment on the RS-485 serial link;
- driving of the indications and acquisition of the commands of the INC module
- management of the RS-232C serial communication line with the PC terminal;
- management of the RS-232C serial communication line towards the MODEM and towards an optional external MODEM for connection to specific remote controls on a telephone line;
- management of the ON/OFF type input and output auxiliary signal using the parallel ports;
- storage of the system configuration in a non-volatile memory (EEPROM);
- management of the calendar for the entire system;
- management of the RS-232C and/or RS-485 serial communication lines that can be used for any associated equipment connected on a serial link.
- History management
- Management of control function line: Beacon Restart, Automatic Routine check, Warning detection, Alignment of the Parameter of the intelligent units (Monitors, DMD modules), Searching and Building of the Data requested by the Remote/Local site through PC

Through the CPU and program memories, the CSB module manages:

- INC Module (Indications and Controls);
- local operator interface through PC;
- interface with remote operator via modem to RCSI/RCSE (Remote Control and Status Unit) or MCS by means of dedicated or switched telephone line;
- SI 446 (Status Indicator) auxiliary indicator via the parallel ports;
- association between auxiliary ON/OFF input and output lines (parallel ports);
- serial channel operation;
- an RTC (Real Time Clock) calendar with rechargeable buffer battery;
- I/O configuration non-volatile memories.

The composition of the CSB module, shown in figure 1.18, consists in the following function blocks:

- CPU and memories;
- 6-channel serial lines;
- Parallel ports with 16 input and 16 output lines.

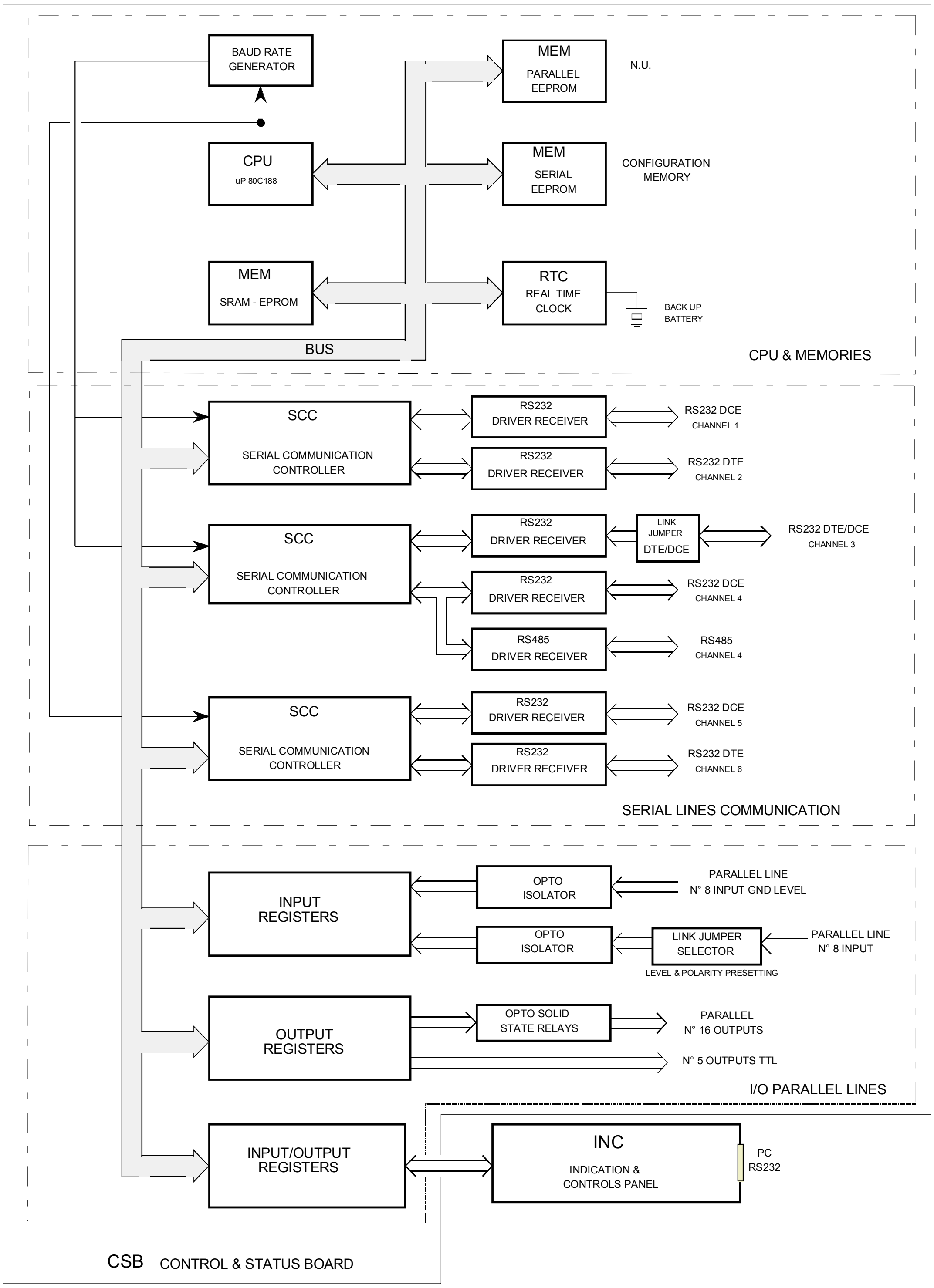


Figure 1.18. CSB module – General Block Diagram

1.6.3.2.1.1 CPU and Memories

The 80C188 type microprocessor works internally with a frequency of 7.3728 MHz by means of a double frequency quartz (it is divided internally by the CPU) and it uses integrated circuits UL6,7,8 to manage the data bus and address buses (see figure 1.19). The 14.7456 MHz quartz frequency is used by the baud rate generator of the SCC (Serial Communication Controller) and passes without alteration from FW2 (in cases of quartz frequency change, the clock can be divided) to provide the BRGSCC signal.

The multiplexed portion of the address bus is stored in two latches (UL6 and UL7) in order to have stable signals during the various CPU cycles.

The data bus is connected to the peripherals and the memories by a bi-directional buffer (UL8). This solution has been used, to overcome not bus electric drive problems, but peripheral problems (such as the RTC that does not release the bus before the CPU starts the next cycle).

A perpetual real time calendar (RTC - Real Time Clock) useful to date the events stored in the “history” is installed to ensure the data concerning events that have taken place in the history of the TACAN equipment is picked up. The manual updating of the date is managed by the “Supervisor” program.

The function is provided by the low consumption integrated circuit (4 μA at 2.2 V) UL5 (RTC) that operates with a 38.768 kHz ceramic quartz.

This updates and supplies the complete actual date to the μP. The RTC memory is not lost when there is no direct voltage since the BT1 buffer battery is switched onto UL5 from IC UL4 that constantly compares the +5 Vdc. If this is missing, a switching electronic device enables the BT1 battery.

Under these conditions, the typical life of the rechargeable NiCd battery (3.6 V and 60 mA/h) is approx. six months.

Through the FW1 circuit (Firmware EPLD - Electrical Programmable Logic Device), the IC UL4 (Supervisory) indicates that the program running will retrigger the timer correctly and consequently LED “WD” (Watch Dog) RD4 will remain alight, indicating that the program running is correctly active.

In the case of a hardware fault or software failure, LEDs RD4 and OPERATION (of the INC) will not light up, indicating that the CSB module is not operating correctly.

Integrated circuit IC UL4, besides monitoring the CPU activity, also checks the level of the +5 Vdc; if this degrades to values below ≤ 4.65 V a “Warning” signal is generated. Integrated circuit IC UL4 also checks the state of the buffer battery, and through the BATF signal indicates the Warning State.

IC UL16 (serial EEPROM) stores the I/O system configuration data, that does not usually vary a lot; it can hold data for about 100 years, and this is the reason why another type of less secure memory (RAM) is not used with a buffer battery.

RESET push-button I1 is used to restore and reinitialize the CPU program.

Integrated circuits FW1 and FW2 are specifically programmed to decode the selection of memories and I/O peripherals, and to generate a clock for the serial port controllers.

The EPROM memories for the program (M7) and SRAM (UL9) have memories a capacity of 1 Mbit (128k x 8), but other sizes can be installed, up to the maximum μP addressing capacity (8 Mbit).

There is another socket on the printed circuit (not usually used) where an SRAM/EEPROM with capacity up to 8 Mbit can be installed.

The UL9 SRAM memory where the events (history) data are loaded is always powered. When there is no +5 Vdc supply, this is substituted by the rechargeable buffer battery. By correctly setting the jumpers on the CSB board, the other optional memories can also be supplied by the buffer battery. In this case, the battery life will be reduced to 2 months.

For the memory rate, with a 10 MHz clock and a 16 MHz CPU, memories with an access time of 100 ns are sufficient.

UL2 is an analog switch that electrically isolates the SRAM when operating by battery.

When the LOW LINE signal is present, activated each time the VDC drops below 4.65 V, the RTC circuit is electrically isolated from UL2 to prevent undesired access and reduce consumption to a minimum in stand-by conditions (battery powering).

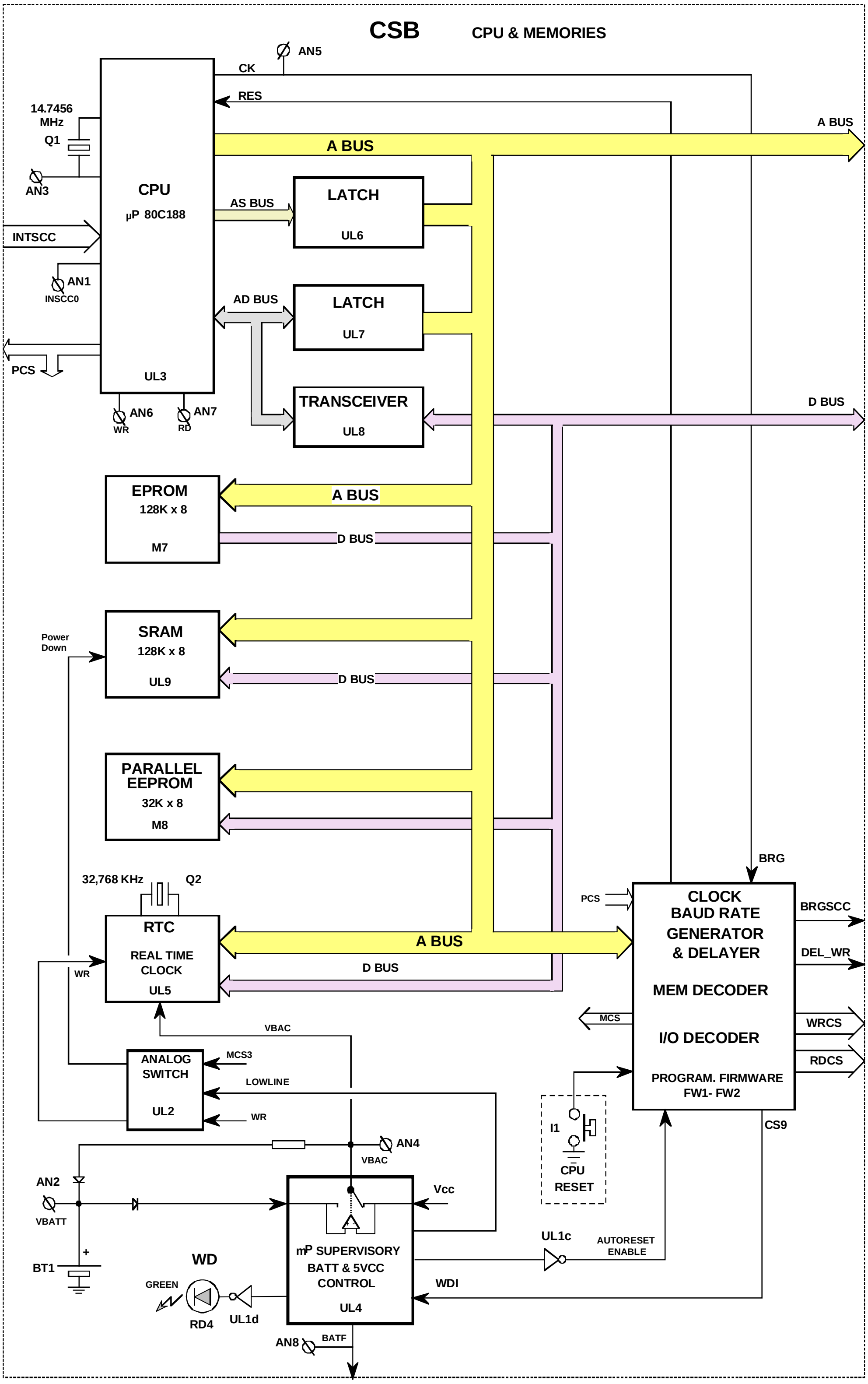


Figure 1.19. CSB module – CPU and Memories: Block Diagram

1.6.3.2.1.2 Serial Lines

There are six serial communication channels in the RS-232C configuration (figure 1.20 block diagram), or five in the RS-232C configuration and 1 in the RS-485 configuration which can be selected by suitable jumpers.

The transmission rate is selected during the configuration stage.

Channel 1, 2, 3 and 4 outputs transit on the 64-pin M22 speedy connector that can be used on the I/O panel connectors SK1, PL1, SK2 for channels 1, 2 and 4 respectively whereas channel 3 is used for communication with the equipment (of SK2-IRS module). Channel 4 on SK2 is preset in RS-232C configuration, whereas selecting the M24 connector jumpers it transits on connector M30 (10-pin speedy) that can be preset in RS-485 configuration. Channel 5 and 6 outputs through connector M53 (34-pin speedy) are brought onto PL4 and PL2 of the I/O panel.

Serial channel 1
Channel 1, managed by UL21 SCC (Serial Communication Control) and driven by IC “UL22” (RS-232 Driver Receiver) is in the DCE standard (Data Communication Equipment) RS-232C configuration and is connected to the PC through connector SK1 on the I/O panel. The PC can be connected to the INC module SK6 (PC RS232) connector as this is in parallel directly to the I/O panel connector SK1.

Serial channel 2
Channel 2, managed by UL 21 SCC (Serial Communication Control) and driven by IC “UL23” (RS-232 Driver Receiver) is in the DTE standard (Data Terminal Equipment) RS-232C configuration and can be connected to the possible external modem via PL1 on the I/O panel. Signals synchronizing the receiving and transmission clocks (RXCK and TXCK) are to be used for modem.

Serial channel 3
Channel 3, managed by UL26 SCC (Serial Communication Control) and driven by IC “UL30” (RS-232 Driver Receiver) can be either RS-232C DCE or DTE configuration according to the arrangement of the M31 connector jumpers.
It communicates with the beacon through the IRS interface in DCE configuration.

Serial Channel 4
Channel 4, managed by UL26 SCC (Serial Communication Control) and driven by IC “UL29” (RS 232 Driver Receiver) is in the DCE standard RS-232C configuration, when connected to M22; it is in the RS-422/485 configuration driven by Drivers/Receivers UL24, UL28, UL25, UL31 if connected to M30.
The transformation from the RS-232C configuration to RS-422/485 configuration is preset through the jumpers of connector M24 that switch the RXD signals either on IC UL29 (RS-232C) or on UL24 (RS-422/485).
RS-422/485 can be used with 4 or 2 wires by suitably setting the jumpers of connector M25.
RD8 and RD9 LEDs driven by UL1f and UL27b, when flashing, indicate respectively the RXD and TXD data transit and indicate that channel 4 is working efficiently.

Serial channels 5 and 6
Channels 5 and 6, managed by UL32 SCC (Serial Communication Control) and driven by IC “UL33 and UL34” (RS-232 Driver Receiver) are in the RS-232C DTE configuration, the use of which is conventionally defined as connection on PL4 and PL2 of the I/O panel for modem.

NOTE

Generally, the DTE configuration can be directly connected to the modem and the DCE to the PC. To connect a DCE channel to another DCE channel or another DTE, a “null modem” adapter is necessary.

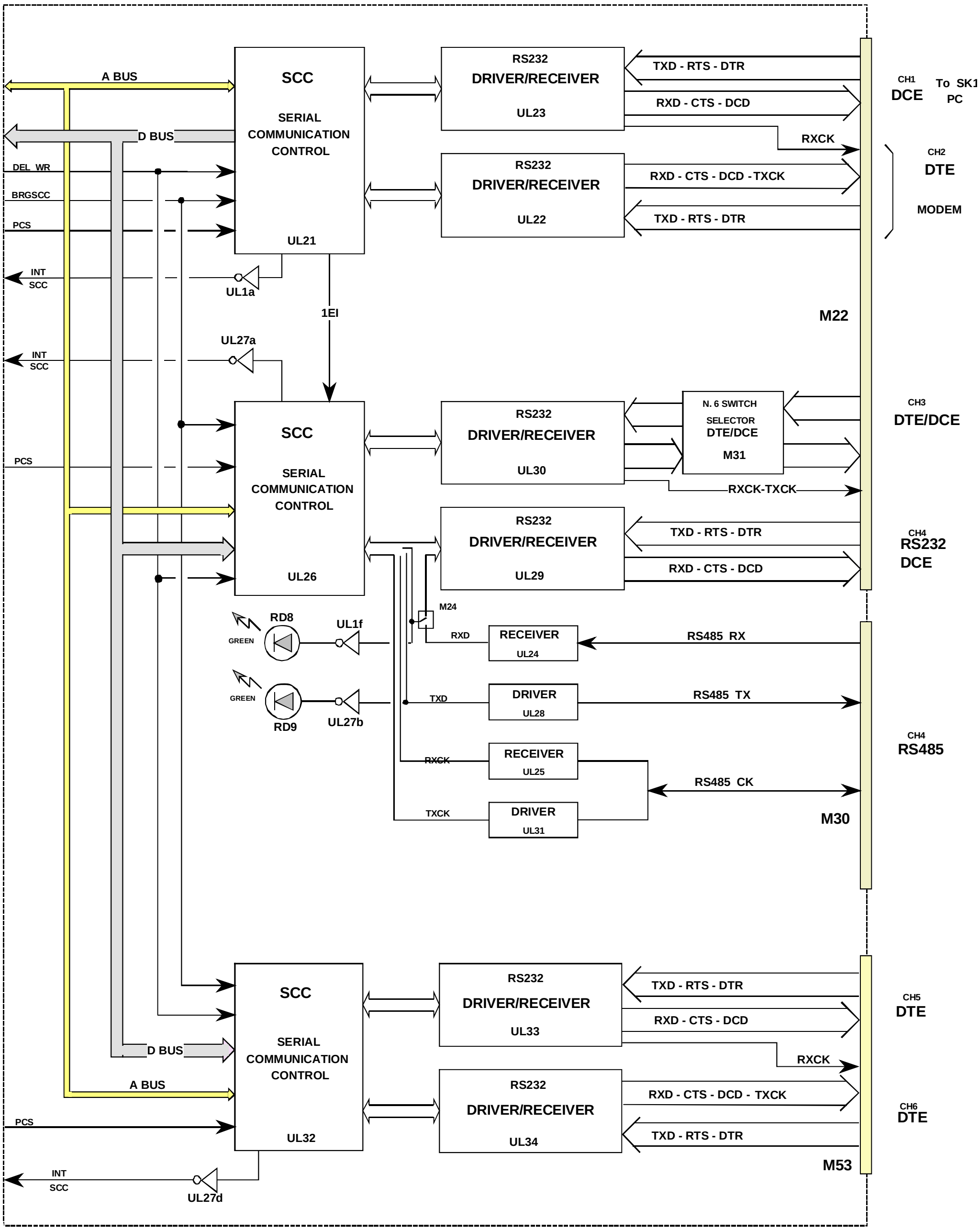


Figure 1.20. CSB module – Serial lines: Block Diagram

1.6.3.2.1.3 Parallel ports

The parallel ports are divided into (see figure 1.21):

– Input ports:

8+8 optoisolated lines (galvanic isolation) for the user's specific applications such as: maximum or minimum temperature level alarms, presence of smoke, anti-vandal alarms, obstacle lights operation check etc.;

4 TTL level lines used by the beacon;

6 bits to interface INC panel commands;

16 optional lines on CSX expansion board upon specific request from the user.

– Output ports:

16 optoisolated solid state relay lines, that can be used (by the user) as indication signals

5 TTL level lines;

16 bits to interface the INC Module indications;

16 optional lines on the CSX expansion board upon user's request.

- Input lines. The lines transit from connector M32 to connector PL3 on the I/O panel and are divided as follows:

8 lines (IAUX 0...7) in two groups of four lines, which have one common for each group.
Each line, by means of its optoisolator, drives two 4-bit input registers (UL19a and UL19b), one for each group.
The electrical characteristics of the control levels must include a contact to ground, and a typical current value of 3mA, maximum 30 mA (max. 500 mAp @ 100 μs).

8 lines (IAUX 8...15) made up of two groups of four lines, with one common for each group.
Each line, through its optoisolator, drives two 4-bit input registers (UL20a and UL20b), one for each group.
The electrical characteristics of the control levels may include a contact to ground or a positive level, according to the arrangement of the line through the jumpers of connectors M49, M50, M51 and M52 (two lines each) and a typical current of 3 mA, maximum 30 mAp (max. 500 mAp @ 100 μs).

NOTE

Lines IAUX10 to IAUX15 are used internally by the equipment and therefore are not available for the user.

4 lines (IN 0...3), TTL level, to determine the primary power supply functioning of the BCPS unit.
Each line drives an 8-bit input register (UL14 e).
On I/O panel connector SK4, lines IN0 and IN1, parallel to those on I/O panel connector PL3, are available through connector M30.

The six bits (CPI1, 2,3) coming from the encoder of the INC module controls, drive the 4-bit input registers UL13a and UL13b.

- Output lines. The lines transit from connector M32 to I/O panel connector SK4. They are divided as follows:

16 lines (OAUX 0...15) in four groups of four lines, with one common for each group.
The lines are driven by two output registers (UL17 and UL18) where each register controls 8 outputs.
Each line controls an electronic optorelay that has the following output features:

  - Max. applied voltage: 350 Vp;
  - Max. current: 100 mAp (100 mA @ ± 7 V load);
  - Closing resistance: 50 Ω
  - Leakage current at 300 V: 40 μA;

5 TTL lines are also available, three on connector SK4 and two on I/O panel connector PL3.
They are driven by the 8-bit output register UL12 that exchanges the data of the EEPROM serial memory UL16 via UL15a and the "Serial Clock" and "Serial Data" signals.

Through the 8-bit output registers UL10 and UL11, the 16 bits of the CPD and CPA buses drive the sequence of indications on the INC Module.

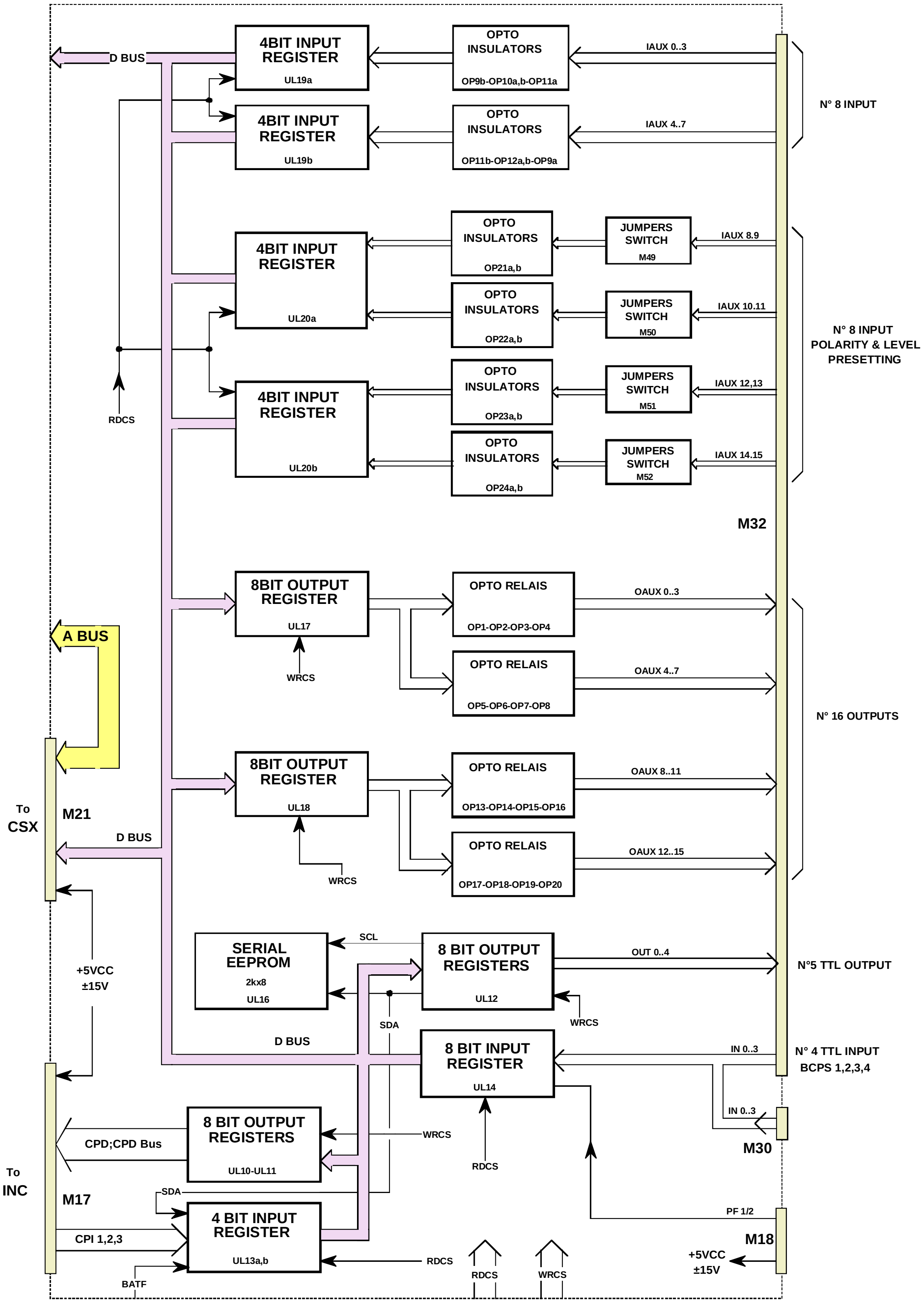


Figure 1.21. CSB module – I/O Parallel Ports: Block Diagram

1.6.3.2.2 LOCAL FRONT CONTROL PANEL

The front panel of LCSU (part of the INC module) is shown in figure 1.22.

It is divided in the following parts:

one dedicated to the unit itself, and one dedicated to the equipment.

1) The part dedicated to the LCSU status contains:

- OPERATION connected directly to the "watch dog signal" of the CPU 186,
- WARNING not used and always off,
- DATA COM not used and always off,
- buzzer (S1),
- button SIL to silence the buzzer and the
- LAMP TEST button;

2) The part dedicated to the equipment comprises the following sections:
beacon MAIN STATUS indications: this section includes the four alphanumerical devices for beacon site code, the ALARM, WARNING, NORMAL and DATA COM general status indications.

3) DETAILED STATUS indications; these indications are requested by the operator by pressing the SELECT button, the triangular sign indicates enabling of the following detailed indications:

- ALARM, STBYALRM, FAULTY and BYPASSED are monitor indications:

  MON 1/2 alarm, MON 1/2 stand by alarm, MON 1/2 faulty, MON 1/2 bypass

- ON, WARNING, FAULTY and ON ANT are transponder indications:

  TX 1/2 on, TX 1/2 warning, TX 1/2 faulty, TX 1/2 on ant.

a) For each MONITOR indication(Mon1 & Mon2):

- ALARM - Means the monitor see an alarm on the transponder on antenna
- STBYALRM - Means the monitor see an alarm on the transponder on dummy load
- FAULTY - Means the monitor found itself wrong
- BYPASSED - Means the monitor is bypassed because the beacon is in Maintenance Mode

b) For each TRANSPONDER indication (TRX1 & TRX2):

- ON - Means the transponder is ON (radiating if it is on antenna)
- WARNING - Means the transponder found a warning condition (e.g. different command by monitors)
- FAULTY - Means the transponder is faulty
- ON ANT - Means the transponder is on antenna

4. Station control (CONTROL STATION):
- Indication of control enabled by a remote control (ENGAGED),
- Indication of local control enabled (ENABLED).
- Priority activation/de-activation button in local control (REQUEST RELEASE).
- Indication of mains failure (MAINS OFF).
- Indication of optional site alarms (ENV ALARM).
- Indication of optional antenna alarm (ANT FTY) – Not used on the DME

– General indication of the faults that may occur in the equipment (OTHER WARN).

5. Beacon commands (COMMAND):
   – ON/OFF button (EQUIP ON/OFF) and
   – transponder on antenna change over (CHANGE OVER).

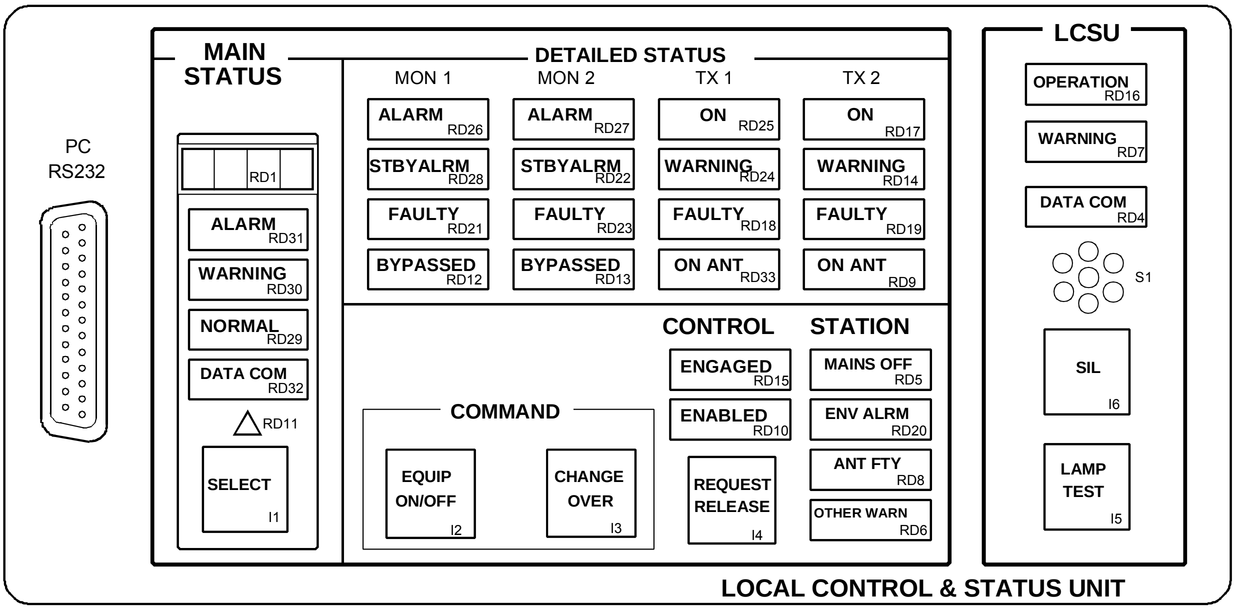


Figure 1.22. Local Front Panel

1.6.3.2.2.1 INDICATION AND CONTROLS - INC Module - functional description

The INC Module block diagrams are shown in figures 1.23, 1.24, 1.25.
All the electrical components are mounted on the INC module board. A transparent waterproof membrane protects the luminous components.
The commands from I1 to I16 have a common ground and communicate with the CSB module register through the encoder consisting in UL14a,b,c - UL15a - UL11e,f - UL8b. The program reads the coded data by "polling" and the "debounce" is foreseen by software. The three six-bit signals (CPI 1, 2, 3) pass from module INC connector M1 to connector M17 when module CSB is inserted.
The communication for program data exchange is through the CPA and CPD buses controlled by CSB module registers UL10 and UL 11.
The circuits are divided into the following blocks:

Address Decoders
Circuits UL3 and UL4 generate the flip-flop chip selects and the alphanumeric display.

Brightness Control
currents are at the set value.
The brightness of the OPERATION LED-bar is controlled separately by circuits UL11a, UL12a, UL11d and UL11a,b.
A single current peak limiter circuit (TR1 and UL3) for all the LED-bars, reduces the transient currents to values that do not jeopardize the components.

LED-bar and driver
Flip-flops UL6, 10,13,16 each control groups of 8 LED-bars. Each LED-bar has four separate LEDs in order to have a wide lighted surface.
The four-digit device on the alphanumeric display (RD1) is an integrated component, with its functions, including the luminous elements, built in the chips.

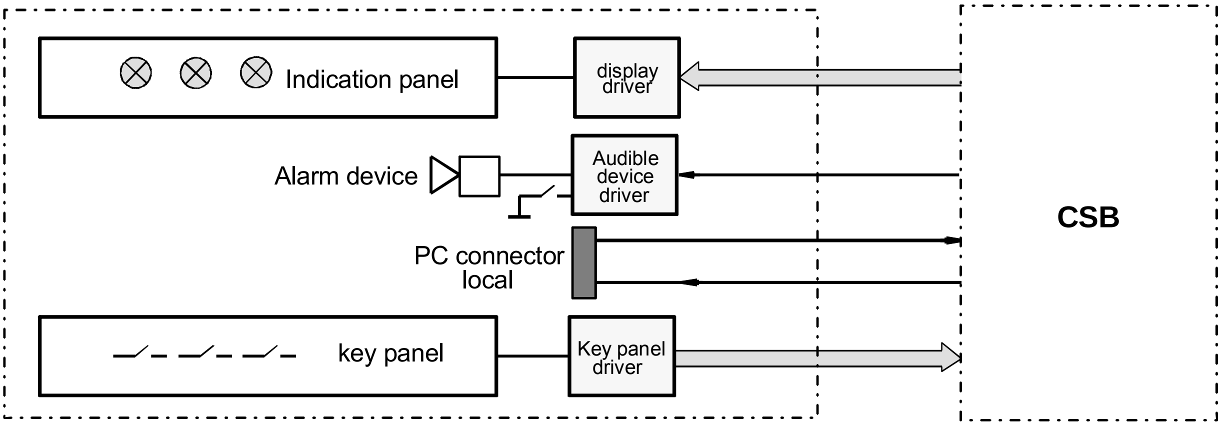


Figure 1.23. INC module - simplified block diagram

Siren (Buzzer)

A siren with a fixed frequency is controlled by flip-flop UL1 and it can be silenced manually through command 16.

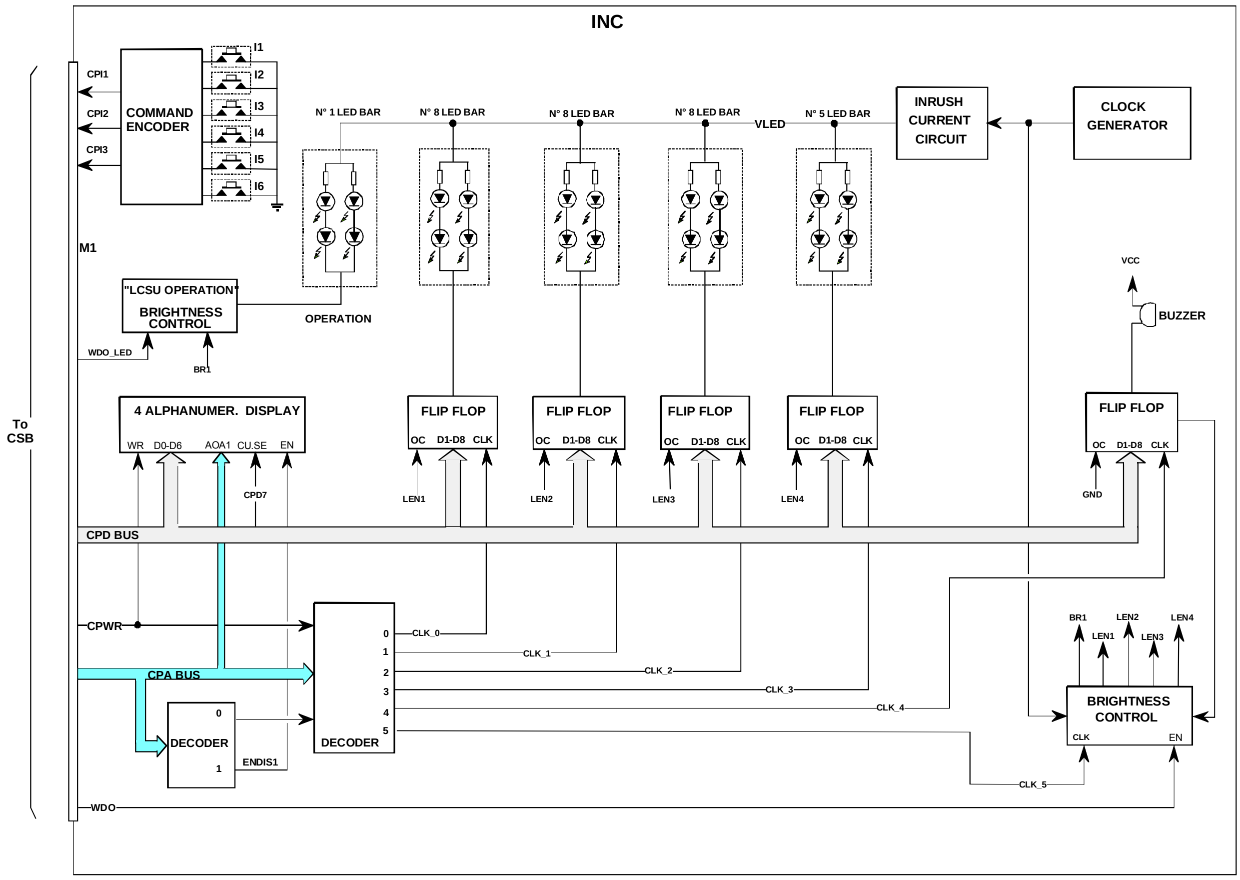


Figure 1.24. INC Module - Indication and Control: General Block Diagram

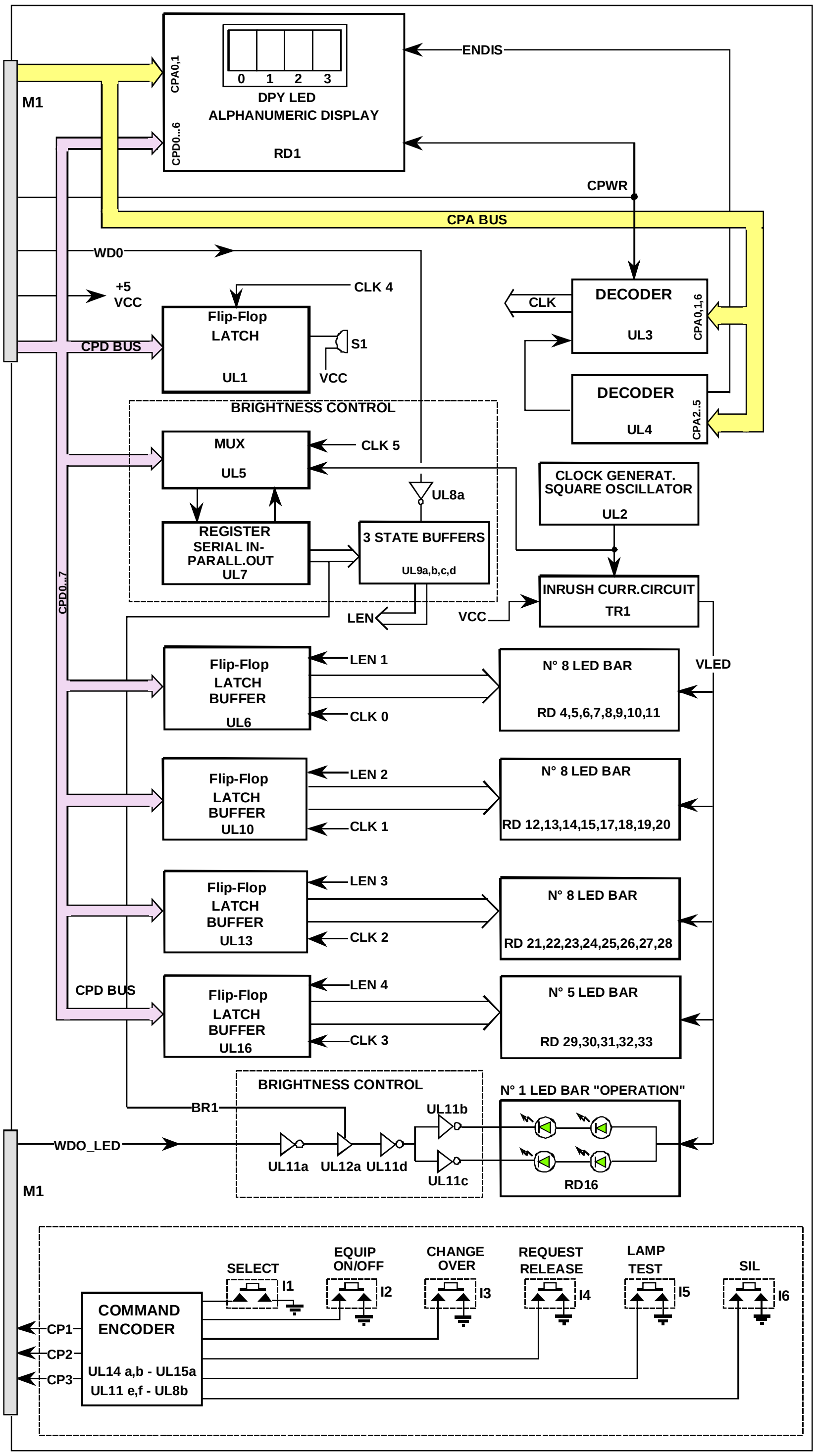


Figure 1.25. INC Module - Indication and Control: Block Diagram

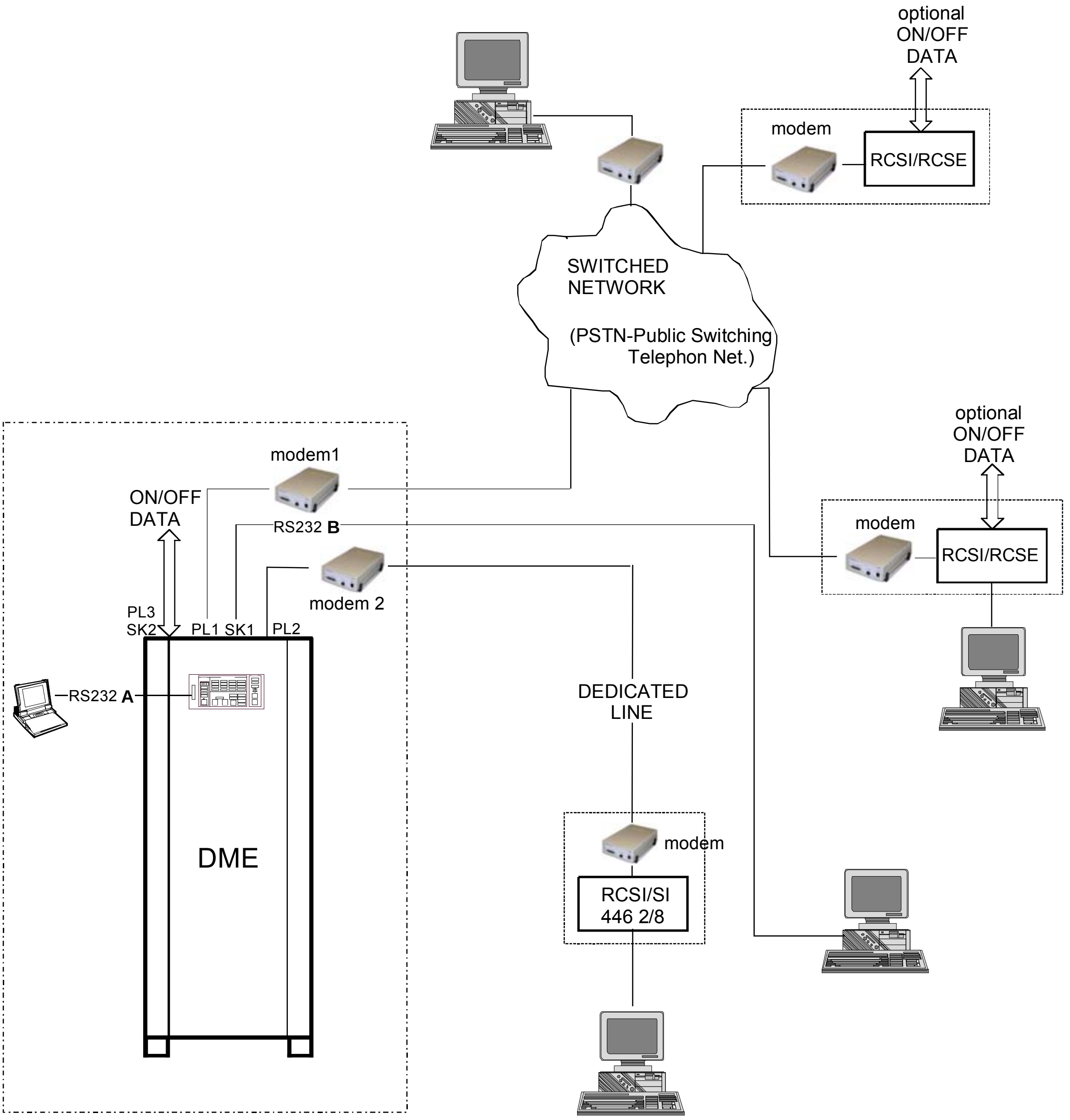
1.6.3.3 REMOTE CONTROL SYSTEM

RCSI 446 or RCSE 443 – Remote Control & Status Indicator - is a unit for remote control and maintenance operations (for detailed information to see RCSI 446 or RCSE 443 Technical manual).

An updated remote control, MCS (Monitoring and Control System), with resident software on PC, work with modern programs that only run on hardware of a typical PC (for detailed information to make reference to the MCS Technical manual)

The possible remote site connections with the local station are shown in figure 1.26.

The examples of remote site connections with the local station are shown in figures 1.27 and 1.28.



NOTE

1) RS232 line (**A)** UNAVAILABLE if
   RS232 line (**B)** is used or viceversa
2) "External" MODEM 1&2 Unavailable
   if "Internal" MODEM are used and viceversa

Figure 1.26. Possible connection between Remote RCSI/RCSE and Local site

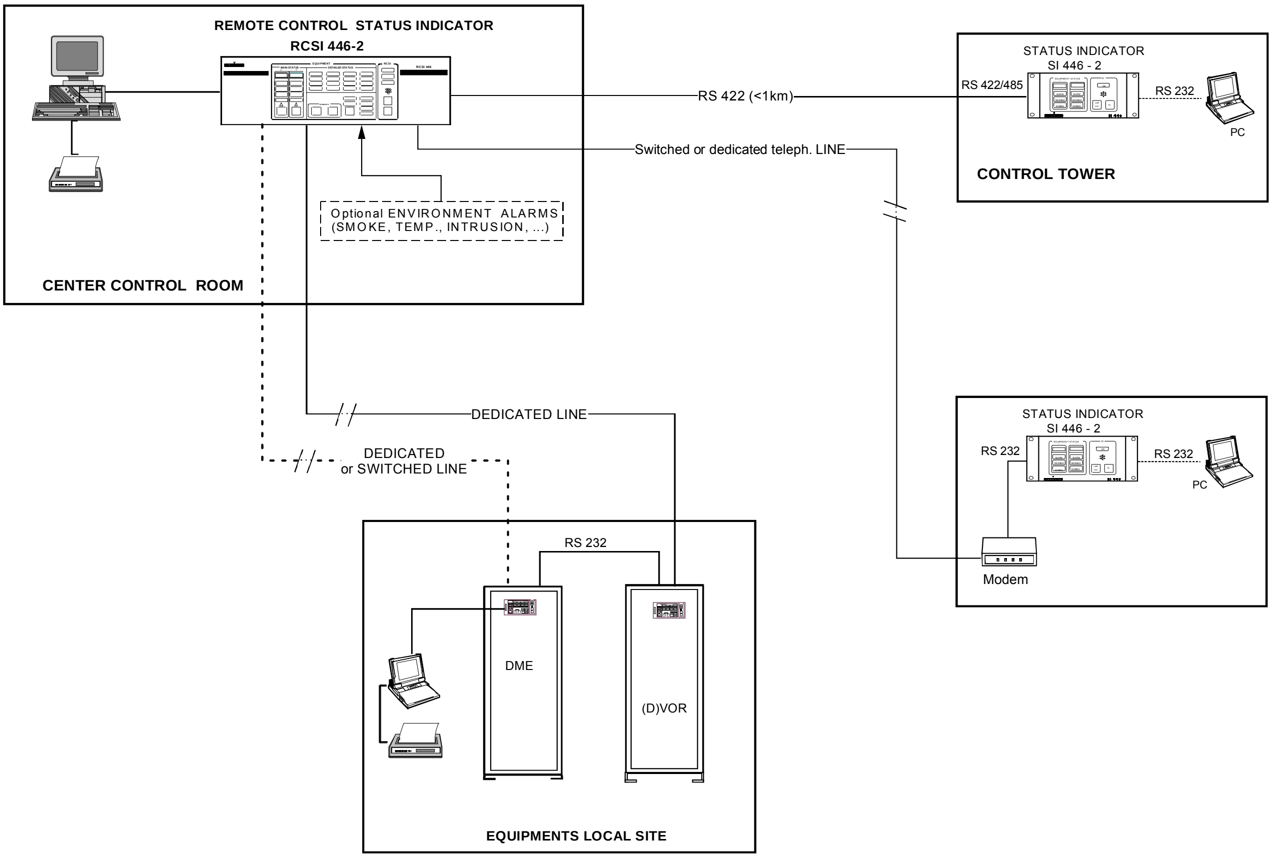
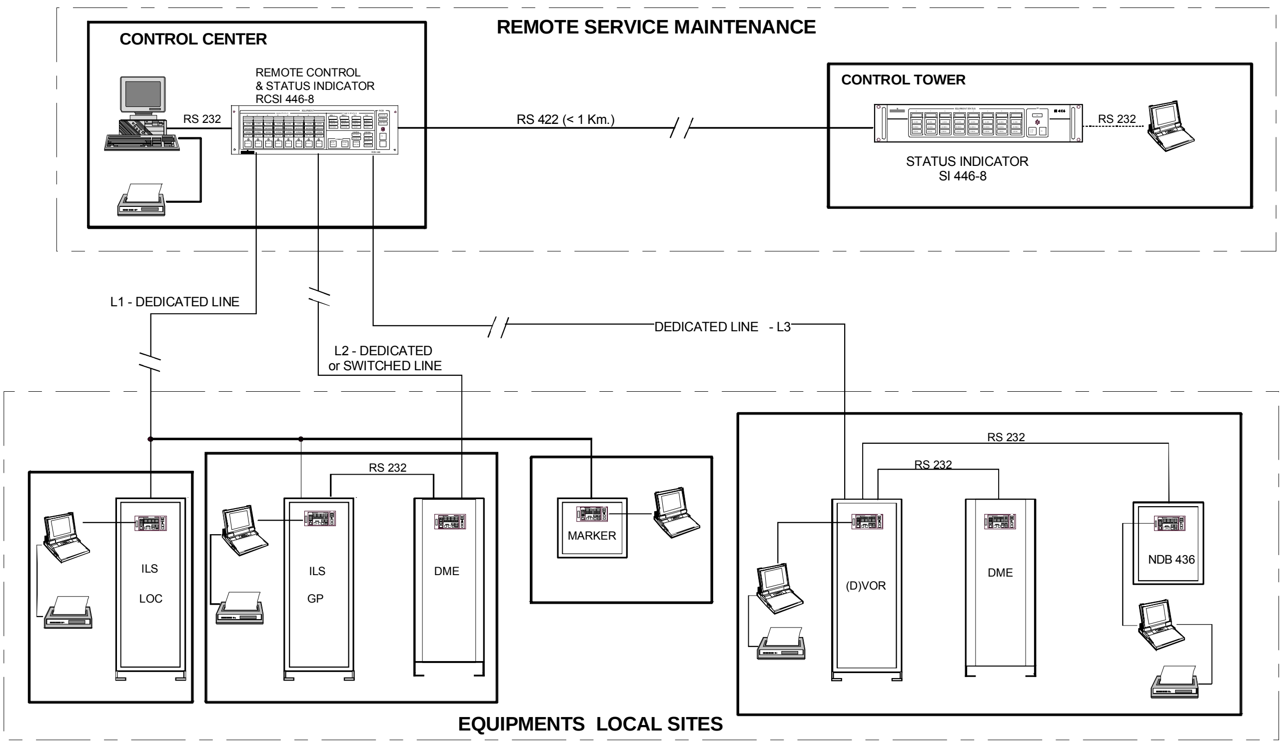
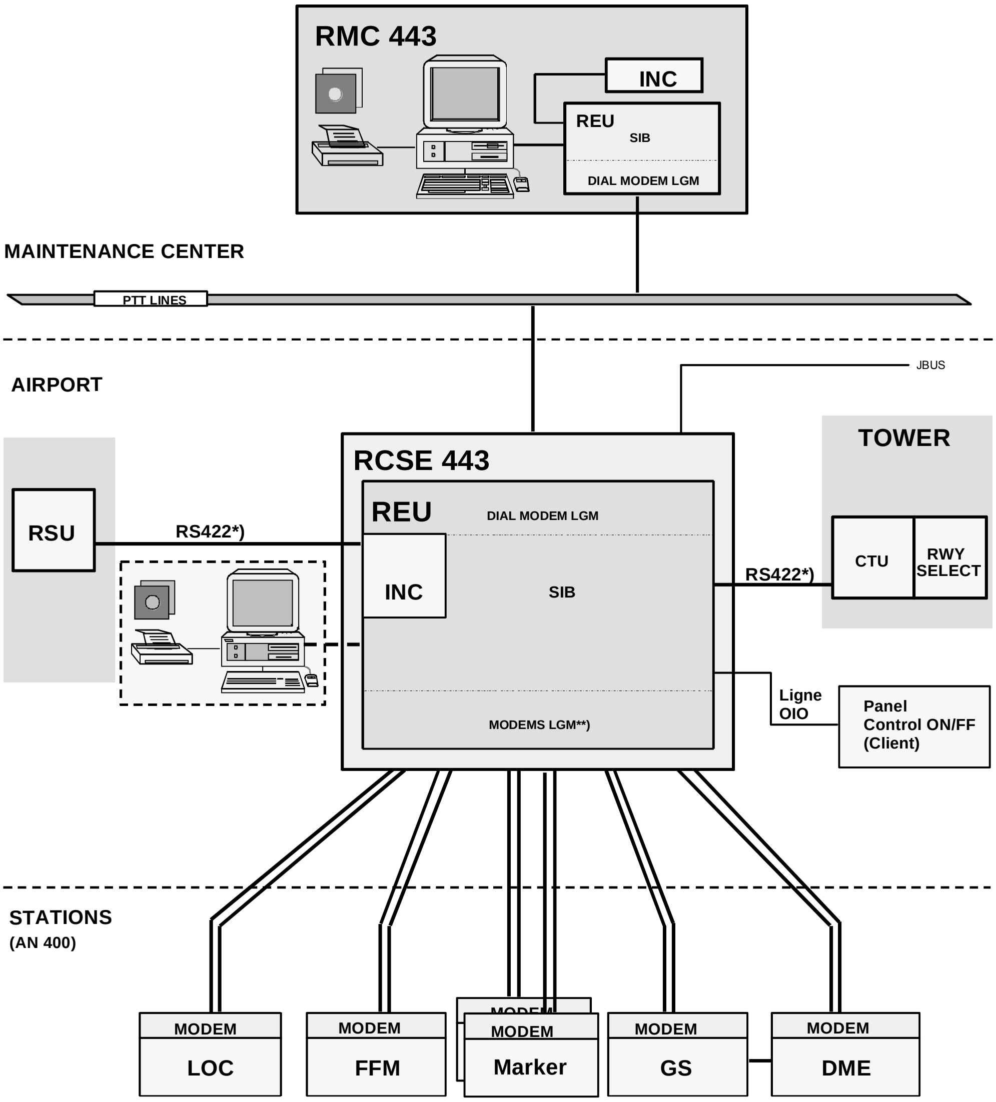


Figure 1.27. Example of single site connection with RCSI



Telephon line 1 = dedicated line connetting with Modem party-line
Telephon line 2 = dedicated or switched line used for: measurement, preset and indication, (no commands) , connetting with Modem. Indication are displayed on PC connecting at RCSI
Telephon line 3 = dedicated line connetting with Modem

Figure 1.28. Example of multi site connection with RCSI



*) RS422 interface to equipment situated in a different building than RCSE - LGM Extender 2 Unit has to be used!

**) alternatively the ILS stations can be connected via RS232 or RS422 dedicated lines to the RCSE (Multiplexer RS232 board is used in RCSE, RS232 interfaces instead of ZUA modem withinILS stations)

Figure 1.29. Example of multi site connection with RCSE

1.6.3.3.1 Remote Control & Status Indicator (RCSI 446)

The RCSI 446 is used by a remote site to control both the beacon and other equipment or devices of the local site.
Two versions are available: RCSI 446-2 to handle up to two equipment and RCSI 446-8 to handle up to eight equipment. Both units might be connected through dedicated lines, switched lines, radio link, etc.
Main functions of the RCSI:

- sends basic controls to the equipment (one equipment at a time; equipment(s) may also be of different types);
- displays the status of the equipment;
- drives supplementary Status Indicators (SI 446);
- interfaces the PC to control-monitor the equipment and to perform maintenance operations like the LCSU at the local site.

The RCSI 446-2/8 is housed in a standard 19" rack container. It comprises:

- the Control & Status Board (CSB386 module)

- the front panel (made with water – proof elastic membrane) for commands and indications. The LEDs and pushbuttons are mounted on the INC-2 or INC-8 board module. The front panel replicates the INC module of the LCSU, plus eight status indication sections for any related equipment
- the modem(s) (optional) capable to operate with dedicated/switched lines up to 28.800 bps; up to three modems can be housed inside the unit rack.
- the power supply (ac/dc or dc/dc alternatively).

The rack RCSI 446 - 8 is shown in Figure 1.30.

For further information, refer to the specific manual of the RCSI.

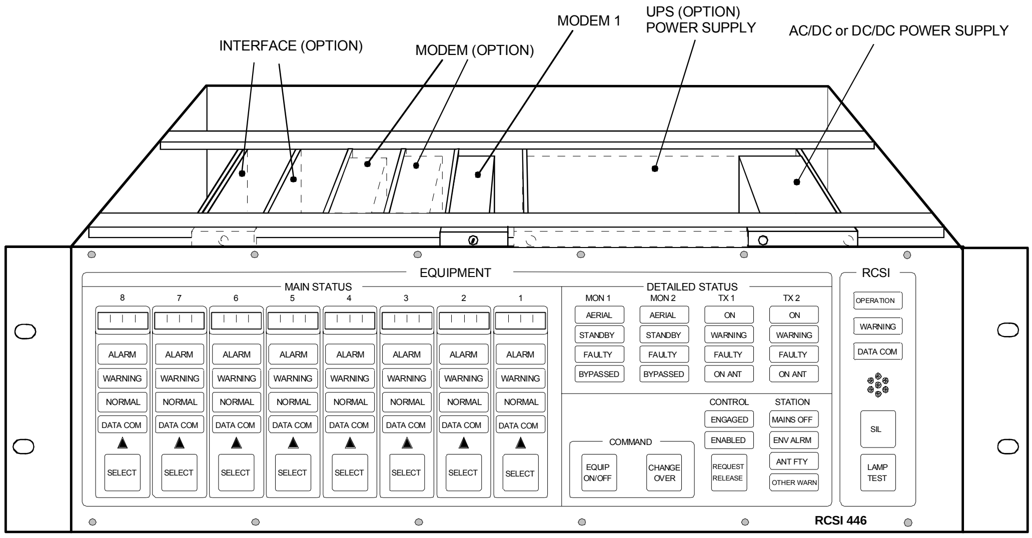


Figure 1.30. RCSI-8 – Remote control

1.6.3.3.2 Remote Control and Status Equipment (RCSE)

The RCSE is intended to be installed in the maintenance equipment room. It provides separate status display and on/off-control functions for all Navaids equipment, and mechanisms to change and display auxiliary data words for MLS. The RCSE consists of the Remote control Electronic Unit (REU) with an Indication and Control (INC) panel. The RCSE is interfacing with one or two Control Tower Units (CTU), with a maintenance data terminal (PC) and optionally with a slave RCSE panel unit defined as Remote Status Unit (RSU). The CTU is intended for installation in the ATC control tower. It provides system 'main status' indications and may provide a separate status display for each Navaids subsystem as well as switching the ILS or MLS to the active runway (RWY-select, optional).

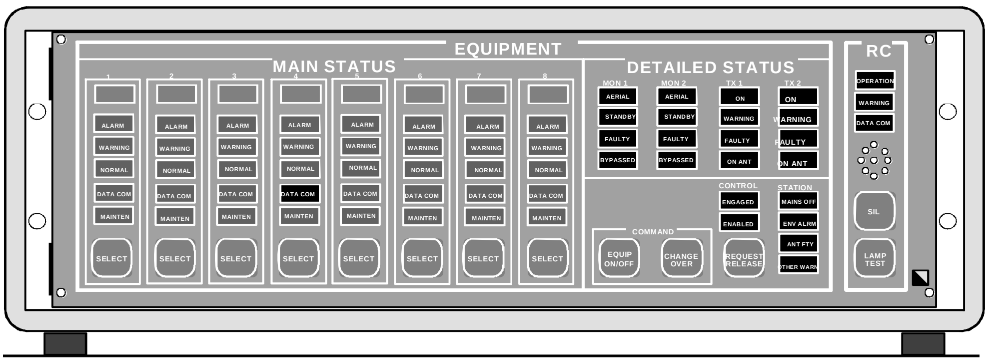


Figure 1.31. RCSE 443 – Remote control

The front RCSE 443 is shown in Figure 1.31 and CTU & Runway select , optional in figure1.32.

For further information, refer to the specific technical manual of the RCSE.

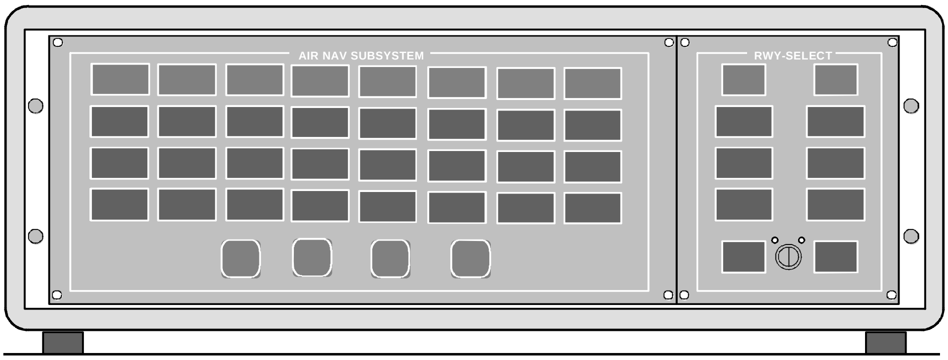


Figure 1.32. RCSE 443 – Remote control CTU & RunWay select

1.6.3.3.3 MCS

The RMMC network has a radially configured architecture based on communication between Monitoring and Control Systems (MCS) on different levels, local (airport) and remote (regional, national, international). The MCS systems are connected via WAN/LAN Internet or via switched/private lines in the public network (PTT) and dedicated lines in private networks. A direct Navaids shelter access is possible via a serial or (optionally) via an Ethernet connection.
With the use of the MCS for control and monitoring via personal computer (PC) a user-friendly interface for the supervision adjustment and modification of relevant operating data according to the respective operational application is made available for first set up and ongoing operation of the terrestrial and satellite navigation equipment (e g. VOR, DME, ILS, MLS, ADS-B). The use of common PC standards and operating systems ensures a familiar operating environment for the user (see figure 1.33).
For detailed further information, refer to the specific technical manual of the MCS.

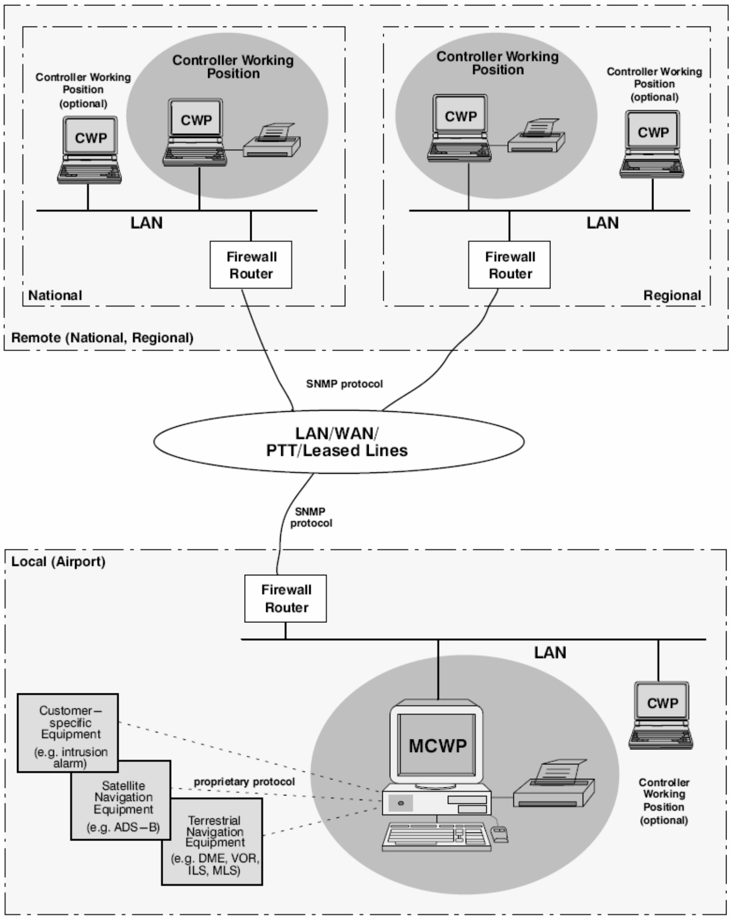


Figure 1.33. MCS – Remote control