AYALON HIGHWAYS
ANY WAY YOU CHOOSE

VOLUME E1

# Metropolitan Urban Traffic Control System (MUTC)

# Statement of Work - Appedices

**Online Tender No. 36/26**



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## Appendix 1 – list of municipalities

This list contains only already connected municipalities to the current UTC system and amount of traffic controllers. The actual number of connected traffic controllers may change until the MUTC will be installed.

**Mantam Dan**

Bat-Yam - 24

Bnei-Brak – 29

Givatayim - 13

Holon - 55

Kiryat Ono – 18

Lod - 11

Netivei Ayalon Road Authority – 14

Petah Tikva - 6

Ramat Gan – 58

Blue Line and Brown BRT projects – about 200

**Mantam Hamifratz**

Acre - 32

Carmiel - 10

Nesher – 20

Kiryat Ata – 14

Kiryat Bialik - 3

Kiryat Motzkin - 16

Kiryat Yam – 12

Nofit light rail project – 36

Haifa - 197



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# Appendix 2 – Inbar Traffic light timing plan parameters definitions

| **Programs 1 - 32** | | | | |
|---|---|---|---|---|
| Parameter Order | **Parameter Number** | **GroupName** | **Parameter Desc** | **[Units]** |
| 1 | 51 | ProgAttribute | Green wave Offset | sec |
| 2 | 52 | ProgAttribute | PedMaxRed | sec |
| 3 | 53 | ProgAttribute | CycleTime | sec |
| 4 | 54 | ProgAttribute | Structure No. | # |
| 5 | 55 | ProgAttribute | Is Cross Master | IsInGreenWave=TRUE AND EYALIsCrossMaster=TRUE THEN IsCrossMaster=1 IsInGreenWave=TRUE AND EYALIsCrossMaster=FALSE THEN IsCrossMaster=2 IsInGreenWave=FALSE THEN IsCrossMaster= 0 |
| 6 | 56 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase1 | sec |
| 7 | 57 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase2 | sec |
| 8 | 58 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase3 | sec |
| 9 | 59 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase4 | sec |
| 10 | 60 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase5 | sec |
| 11 | 61 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase6 | sec |
| 12 | 62 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase7 | sec |
| 13 | 63 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase8 | sec |
| 14 | 64 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase9 | sec |
| 15 | 65 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase10 | sec |
| 16 | 66 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase11 | sec |
| 17 | 67 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase12 | sec |
| 18 | 68 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase13 | sec |
| 19 | 69 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase14 | sec |
| 20 | 70 | Simple Phase/AnchorPhase | SP:MinEndtime/MinDuration/MinSpecial AP:StartTime Phase15 | sec |
| 21 | 71 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase1 | sec |
| 22 | 72 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase2 | sec |
| 23 | 73 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase3 | sec |
| 24 | 74 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase4 | sec |
| 25 | 75 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase5 | sec |
| 26 | 76 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase6 | sec |



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| | | | | |
|---|---|---|---|---|
| 27 | 77 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase7 | sec |
| 28 | 78 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase8 | sec |
| 29 | 79 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase9 | sec |
| 30 | 80 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase10 | sec |
| 31 | 81 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase11 | sec |
| 32 | 82 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase12 | sec |
| 33 | 83 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase13 | sec |
| 34 | 84 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase14 | sec |
| 35 | 85 | Simple Phase/AnchorPhase | SP:MaxEndtime/MaxDuration/MaxSpecial AP:StartTime Phase15 | sec |
| 36 | 86 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase1 | sec |
| 37 | 87 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase2 | sec |
| 38 | 88 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase3 | sec |
| 39 | 89 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase4 | sec |
| 40 | 90 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase5 | sec |
| 41 | 91 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase6 | sec |
| 42 | 92 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase7 | sec |
| 43 | 93 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase8 | sec |
| 44 | 94 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase9 | sec |
| 45 | 95 | Complexphase | MinEndtime/MinDuration/MinSpecial Phase10 | sec |
| 46 | 96 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase1 | sec |
| 47 | 97 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase2 | sec |
| 48 | 98 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase3 | sec |
| 49 | 99 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase4 | sec |
| 50 | 100 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase5 | sec |
| 51 | 101 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase6 | sec |
| 52 | 102 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase7 | sec |
| 53 | 103 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase8 | sec |
| 54 | 104 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase9 | sec |
| 55 | 105 | Complexphase | MaxEndtime/MaxDuration/MaxSpecial Phase10 | sec |
| 56 | 106 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase1 | sec |
| 57 | 107 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase2 | sec |
| 58 | 108 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase3 | sec |
| 59 | 109 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase4 | sec |
| 60 | 110 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase5 | sec |
| 61 | 111 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase6 | sec |
| 62 | 112 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase7 | sec |
| 63 | 113 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase8 | sec |
| 64 | 114 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase9 | sec |
| 65 | 115 | Complexphase | ExtraMaxEndtime/ExtraMaxDuration/ExtraMaxSpecial Phase10 | sec |
| 66 | 116 | VehMove | ReqCumDuration Move1 | sec |
| 67 | 117 | VehMove | ReqCumDuration Move2 | sec |
| 68 | 118 | VehMove | ReqCumDuration Move3 | sec |



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| | | | | |
|---|---|---|---|---|
| 69 | 119 | VehMove | ReqCumDuration Move4 | sec |
| 70 | 120 | VehMove | ReqCumDuration Move5 | sec |
| 71 | 121 | VehMove | CumPeriod Move1 | 10 sec (i.e. 500 sec will be defined as 50) |
| 72 | 122 | VehMove | CumPeriod Move2 | 10 sec |
| 73 | 123 | VehMove | CumPeriod Move3 | 10 sec |
| 74 | 124 | VehMove | CumPeriod Move4 | 10 sec |
| 75 | 125 | VehMove | CumPeriod Move5 | 10 sec |
| 76 | 126 | VehMove | VehMaxRed/QueueMaxDuration Move1 | sec |
| 77 | 127 | VehMove | VehMaxRed/QueueMaxDuration Move2 | sec |
| 78 | 128 | VehMove | VehMaxRed/QueueMaxDuration Move3 | sec |
| 79 | 129 | VehMove | VehMaxRed/QueueMaxDuration Move4 | sec |
| 80 | 130 | VehMove | VehMaxRed/QueueMaxDuration Move5 | sec |
| 81 | 131 | PTMove | PT_DirectionPriority PTMove1 | # |
| 82 | 132 | PTMove | PT_DirectionPriority PTMove2 | # |
| 83 | 133 | PTMove | PT_DirectionPriority PTMove3 | # |
| 84 | 134 | PTMove | PlatoonPriorityFactor/PTMaxTT PTmove1 | #/minutes |
| 85 | 135 | PTMove | PlatoonPriorityFactor/PTMaxTT PTmove2 | #/minutes |
| 86 | 136 | PTMove | PlatoonPriorityFactor/PTMaxTT PTmove3 | #/minutes |
| 87 | 137 | PTDirectionLine | AssumedTimeFromDetectionToTarget Line1 | sec |
| 88 | 138 | PTDirectionLine | AssumedTimeFromDetectionToTarget Line2 | sec |
| 89 | 139 | PTDirectionLine | AssumedTimeFromDetectionToTarget Line3 | sec |
| 90 | 140 | PTDirectionLine | AssumedTimeFromDetectionToTarget Line4 | sec |
| 91 | 141 | PTDirectionLine | AssumedTimeFromDetectionToTarget Line5 | sec |
| 92 | 142 | PTDirectionLine | AssumedTimeFromDetectionToTarget Line6 | sec |
| 93 | 143 | PTDirectionLine | DesiredHeadway Line1 | sec |
| 94 | 144 | PTDirectionLine | DesiredHeadway Line2 | sec |
| 95 | 145 | PTDirectionLine | DesiredHeadway Line3 | sec |
| 96 | 146 | PTDirectionLine | DesiredHeadway Line4 | sec |
| 97 | 147 | PTDirectionLine | DesiredHeadway Line5 | sec |
| 98 | 148 | ProgAttribute | ProgPriorityType_ProgAtt | # |
| 99 | 149 | Detector Programs | Gap Set | # (1-4) |
| 100 | 150 | Detector Programs | Mode Set | # (1-4) |

Detector Program

| Parameter Order | GroupName | Parameter Desc |
|---|---|---|
| 1 | Gap Set | Gap Set 1 Detector 1 |
| 2 | Gap Set | Gap Set 1 Detector 2 |
| 3 | Gap Set | Gap Set 1 Detector 3 |
| 4 | Gap Set | Gap Set 1 Detector 4 |
| 5 | Gap Set | Gap Set 1 Detector 5 |
| 6 | Gap Set | Gap Set 1 Detector 6 |
| 7 | Gap Set | Gap Set 1 Detector 7 |
| 8 | Gap Set | Gap Set 1 Detector 8 |
| 9 | Gap Set | Gap Set 1 Detector 9 |



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| | | |
|---|---|---|
| 10 | Gap Set | Gap Set 1 Detector 10 |
| 11 | Gap Set | Gap Set 1 Detector 11 |
| 12 | Gap Set | Gap Set 1 Detector 12 |
| 13 | Gap Set | Gap Set 1 Detector 13 |
| 14 | Gap Set | Gap Set 1 Detector 14 |
| 15 | Gap Set | Gap Set 1 Detector 15 |
| 16 | Gap Set | Gap Set 1 Detector 16 |
| 17 | Gap Set | Gap Set 1 Detector 17 |
| 18 | Gap Set | Gap Set 1 Detector 18 |
| 19 | Gap Set | Gap Set 1 Detector 19 |
| 20 | Gap Set | Gap Set 1 Detector 20 |
| 21 | Gap Set | Gap Set 1 Detector 21 |
| 22 | Gap Set | Gap Set 1 Detector 22 |
| 23 | Gap Set | Gap Set 1 Detector 23 |
| 24 | Gap Set | Gap Set 1 Detector 24 |
| 25 | Gap Set | Gap Set 1 Detector 25 |
| 26 | Mode Set | Mode Set 1 Detector 1 |
| 27 | Mode Set | Mode Set 1 Detector 2 |
| 28 | Mode Set | Mode Set 1 Detector 3 |
| 29 | Mode Set | Mode Set 1 Detector 4 |
| 30 | Mode Set | Mode Set 1 Detector 5 |
| 31 | Mode Set | Mode Set 1 Detector 6 |
| 32 | Mode Set | Mode Set 1 Detector 7 |
| 33 | Mode Set | Mode Set 1 Detector 8 |
| 34 | Mode Set | Mode Set 1 Detector 9 |
| 35 | Mode Set | Mode Set 1 Detector 10 |
| 36 | Mode Set | Mode Set 1 Detector 11 |
| 37 | Mode Set | Mode Set 1 Detector 12 |
| 38 | Mode Set | Mode Set 1 Detector 13 |
| 39 | Mode Set | Mode Set 1 Detector 14 |
| 40 | Mode Set | Mode Set 1 Detector 15 |
| 41 | Mode Set | Mode Set 1 Detector 16 |
| 42 | Mode Set | Mode Set 1 Detector 17 |
| 43 | Mode Set | Mode Set 1 Detector 18 |
| 44 | Mode Set | Mode Set 1 Detector 19 |
| 45 | Mode Set | Mode Set 1 Detector 20 |
| 46 | Mode Set | Mode Set 1 Detector 21 |
| 47 | Mode Set | Mode Set 1 Detector 22 |
| 48 | Mode Set | Mode Set 1 Detector 23 |
| 49 | Mode Set | Mode Set 1 Detector 24 |
| 50 | Mode Set | Mode Set 1 Detector 25 |
| 51 | Gap Set | Gap Set 2 Detector 1 |
| 52 | Gap Set | Gap Set 2 Detector 2 |
| 53 | Gap Set | Gap Set 2 Detector 3 |
| 54 | Gap Set | Gap Set 2 Detector 4 |
| 55 | Gap Set | Gap Set 2 Detector 5 |
| 56 | Gap Set | Gap Set 2 Detector 6 |
| 57 | Gap Set | Gap Set 2 Detector 7 |
| 58 | Gap Set | Gap Set 2 Detector 8 |



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| | | |
|---|---|---|
| 59 | Gap Set | Gap Set 2 Detector 9 |
| 60 | Gap Set | Gap Set 2 Detector 10 |
| 61 | Gap Set | Gap Set 2 Detector 11 |
| 62 | Gap Set | Gap Set 2 Detector 12 |
| 63 | Gap Set | Gap Set 2 Detector 13 |
| 64 | Gap Set | Gap Set 2 Detector 14 |
| 65 | Gap Set | Gap Set 2 Detector 15 |
| 66 | Gap Set | Gap Set 2 Detector 16 |
| 67 | Gap Set | Gap Set 2 Detector 17 |
| 68 | Gap Set | Gap Set 2 Detector 18 |
| 69 | Gap Set | Gap Set 2 Detector 19 |
| 70 | Gap Set | Gap Set 2 Detector 20 |
| 71 | Gap Set | Gap Set 2 Detector 21 |
| 72 | Gap Set | Gap Set 2 Detector 22 |
| 73 | Gap Set | Gap Set 2 Detector 23 |
| 74 | Gap Set | Gap Set 2 Detector 24 |
| 75 | Gap Set | Gap Set 2 Detector 25 |
| 76 | Mode Set | Mode Set 2 Detector 1 |
| 77 | Mode Set | Mode Set 2 Detector 2 |
| 78 | Mode Set | Mode Set 2 Detector 3 |
| 79 | Mode Set | Mode Set 2 Detector 4 |
| 80 | Mode Set | Mode Set 2 Detector 5 |
| 81 | Mode Set | Mode Set 2 Detector 6 |
| 82 | Mode Set | Mode Set 2 Detector 7 |
| 83 | Mode Set | Mode Set 2 Detector 8 |
| 84 | Mode Set | Mode Set 2 Detector 9 |
| 85 | Mode Set | Mode Set 2 Detector 10 |
| 86 | Mode Set | Mode Set 2 Detector 11 |
| 87 | Mode Set | Mode Set 2 Detector 12 |
| 88 | Mode Set | Mode Set 2 Detector 13 |
| 89 | Mode Set | Mode Set 2 Detector 14 |
| 90 | Mode Set | Mode Set 2 Detector 15 |
| 91 | Mode Set | Mode Set 2 Detector 16 |
| 92 | Mode Set | Mode Set 2 Detector 17 |
| 93 | Mode Set | Mode Set 2 Detector 18 |
| 94 | Mode Set | Mode Set 2 Detector 19 |
| 95 | Mode Set | Mode Set 2 Detector 20 |
| 96 | Mode Set | Mode Set 2 Detector 21 |
| 97 | Mode Set | Mode Set 2 Detector 22 |
| 98 | Mode Set | Mode Set 2 Detector 23 |
| 99 | Mode Set | Mode Set 2 Detector 24 |
| 100 | Mode Set | Mode Set 2 Detector 25 |
| 101 | Gap Set | Gap Set 3 Detector 1 |
| 102 | Gap Set | Gap Set 3 Detector 2 |
| 103 | Gap Set | Gap Set 3 Detector 3 |
| 104 | Gap Set | Gap Set 3 Detector 4 |
| 105 | Gap Set | Gap Set 3 Detector 5 |
| 106 | Gap Set | Gap Set 3 Detector 6 |
| 107 | Gap Set | Gap Set 3 Detector 7 |



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| | | |
|---|---|---|
| 108 | Gap Set | Gap Set 3 Detector 8 |
| 109 | Gap Set | Gap Set 3 Detector 9 |
| 110 | Gap Set | Gap Set 3 Detector 10 |
| 111 | Gap Set | Gap Set 3 Detector 11 |
| 112 | Gap Set | Gap Set 3 Detector 12 |
| 113 | Gap Set | Gap Set 3 Detector 13 |
| 114 | Gap Set | Gap Set 3 Detector 14 |
| 115 | Gap Set | Gap Set 3 Detector 15 |
| 116 | Gap Set | Gap Set 3 Detector 16 |
| 117 | Gap Set | Gap Set 3 Detector 17 |
| 118 | Gap Set | Gap Set 3 Detector 18 |
| 119 | Gap Set | Gap Set 3 Detector 19 |
| 120 | Gap Set | Gap Set 3 Detector 20 |
| 121 | Gap Set | Gap Set 3 Detector 21 |
| 122 | Gap Set | Gap Set 3 Detector 22 |
| 123 | Gap Set | Gap Set 3 Detector 23 |
| 124 | Gap Set | Gap Set 3 Detector 24 |
| 125 | Gap Set | Gap Set 3 Detector 25 |
| 126 | Mode Set | Mode Set 3 Detector 1 |
| 127 | Mode Set | Mode Set 3 Detector 2 |
| 128 | Mode Set | Mode Set 3 Detector 3 |
| 129 | Mode Set | Mode Set 3 Detector 4 |
| 130 | Mode Set | Mode Set 3 Detector 5 |
| 131 | Mode Set | Mode Set 3 Detector 6 |
| 132 | Mode Set | Mode Set 3 Detector 7 |
| 133 | Mode Set | Mode Set 3 Detector 8 |
| 134 | Mode Set | Mode Set 3 Detector 9 |
| 135 | Mode Set | Mode Set 3 Detector 10 |
| 136 | Mode Set | Mode Set 3 Detector 11 |
| 137 | Mode Set | Mode Set 3 Detector 12 |
| 138 | Mode Set | Mode Set 3 Detector 13 |
| 139 | Mode Set | Mode Set 3 Detector 14 |
| 140 | Mode Set | Mode Set 3 Detector 15 |
| 141 | Mode Set | Mode Set 3 Detector 16 |
| 142 | Mode Set | Mode Set 3 Detector 17 |
| 143 | Mode Set | Mode Set 3 Detector 18 |
| 144 | Mode Set | Mode Set 3 Detector 19 |
| 145 | Mode Set | Mode Set 3 Detector 20 |
| 146 | Mode Set | Mode Set 3 Detector 21 |
| 147 | Mode Set | Mode Set 3 Detector 22 |
| 148 | Mode Set | Mode Set 3 Detector 23 |
| 149 | Mode Set | Mode Set 3 Detector 24 |
| 150 | Mode Set | Mode Set 3 Detector 25 |
| 151 | Gap Set | Gap Set 4 Detector 1 |
| 152 | Gap Set | Gap Set 4 Detector 2 |
| 153 | Gap Set | Gap Set 4 Detector 3 |
| 154 | Gap Set | Gap Set 4 Detector 4 |
| 155 | Gap Set | Gap Set 4 Detector 5 |
| 156 | Gap Set | Gap Set 4 Detector 6 |



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| | | |
|---|---|---|
| 157 | Gap Set | Gap Set 4 Detector 7 |
| 158 | Gap Set | Gap Set 4 Detector 8 |
| 159 | Gap Set | Gap Set 4 Detector 9 |
| 160 | Gap Set | Gap Set 4 Detector 10 |
| 161 | Gap Set | Gap Set 4 Detector 11 |
| 162 | Gap Set | Gap Set 4 Detector 12 |
| 163 | Gap Set | Gap Set 4 Detector 13 |
| 164 | Gap Set | Gap Set 4 Detector 14 |
| 165 | Gap Set | Gap Set 4 Detector 15 |
| 166 | Gap Set | Gap Set 4 Detector 16 |
| 167 | Gap Set | Gap Set 4 Detector 17 |
| 168 | Gap Set | Gap Set 4 Detector 18 |
| 169 | Gap Set | Gap Set 4 Detector 19 |
| 170 | Gap Set | Gap Set 4 Detector 20 |
| 171 | Gap Set | Gap Set 4 Detector 21 |
| 172 | Gap Set | Gap Set 4 Detector 22 |
| 173 | Gap Set | Gap Set 4 Detector 23 |
| 174 | Gap Set | Gap Set 4 Detector 24 |
| 175 | Gap Set | Gap Set 4 Detector 25 |
| 176 | Mode Set | Mode Set 4 Detector 1 |
| 177 | Mode Set | Mode Set 4 Detector 2 |
| 178 | Mode Set | Mode Set 4 Detector 3 |
| 179 | Mode Set | Mode Set 4 Detector 4 |
| 180 | Mode Set | Mode Set 4 Detector 5 |
| 181 | Mode Set | Mode Set 4 Detector 6 |
| 182 | Mode Set | Mode Set 4 Detector 7 |
| 183 | Mode Set | Mode Set 4 Detector 8 |
| 184 | Mode Set | Mode Set 4 Detector 9 |
| 185 | Mode Set | Mode Set 4 Detector 10 |
| 186 | Mode Set | Mode Set 4 Detector 11 |
| 187 | Mode Set | Mode Set 4 Detector 12 |
| 188 | Mode Set | Mode Set 4 Detector 13 |
| 189 | Mode Set | Mode Set 4 Detector 14 |
| 190 | Mode Set | Mode Set 4 Detector 15 |
| 191 | Mode Set | Mode Set 4 Detector 16 |
| 192 | Mode Set | Mode Set 4 Detector 17 |
| 193 | Mode Set | Mode Set 4 Detector 18 |
| 194 | Mode Set | Mode Set 4 Detector 19 |
| 195 | Mode Set | Mode Set 4 Detector 20 |
| 196 | Mode Set | Mode Set 4 Detector 21 |
| 197 | Mode Set | Mode Set 4 Detector 22 |
| 198 | Mode Set | Mode Set 4 Detector 23 |
| 199 | Mode Set | Mode Set 4 Detector 24 |
| 200 | Mode Set | Mode Set 4 Detector 25 |



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# Appendix 3 – The Unified format

## 1. General

The unified format is a general guideline and format that the traffic light planning software needs to generate. The actual structure and format that each specific traffic light planning software generate may vary.

The MOT website provides more information and links to the latest version of the unified format –

The guidelines can be found at the following link (English edition)

Latest XSD - link

## 2. The Unified format in XSD format

```
<?xml version="1.0" encoding="utf-8" ?>
<!--Created with Liquid XML Studio 2012 Designer Edition 10.1.7.4256 (http://www.liquid-technologies.com)-->
<xs:schema elementFormDefault="qualified" xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="junction">
    <xs:complexType>
      <xs:sequence minOccurs="1" maxOccurs="1">
        <xs:element name="general" type="general-type" minOccurs="1" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>
                                    General data on project, junction and
                                    designer
                                </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="revision-list" type="revision-list-type" minOccurs="1" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>
                                    Design revisions list
                                </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="approach-list" type="approach-list-type" minOccurs="0" maxOccurs="1" />
        <xs:element name="base-move-list" type="base-move-list-type" minOccurs="1" maxOccurs="1">
          <xs:annotation>
```



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<xs:documentation>

basic move types definition

</xs:documentation>

</xs:annotation>

</xs:element>

<xs:element name="move-list" type="move-list-type" minOccurs="1" maxOccurs="1" />

<xs:element name="evacuation-information" type="evacuation-information-type" minOccurs="1" maxOccurs="1" />

<xs:element name="traffic-volume-list" type="traffic-volume-list-type" minOccurs="0" maxOccurs="1" />

<xs:element name="matrix" type="matrix-type" minOccurs="1" maxOccurs="1" />

<xs:element name="stage-list" type="stage-list-type" minOccurs="1" maxOccurs="1" />

<xs:element name="inter-stage-list" type="inter-stage-list-type" minOccurs="1" maxOccurs="1" />

<xs:element name="program-list" type="program-list-type" minOccurs="1" maxOccurs="1" />

<xs:element name="program-schedule" type="program-schedule-type" minOccurs="0" maxOccurs="1" />

<xs:element name="parameter-list" type="parameter-list-type" minOccurs="0" maxOccurs="1" />

<xs:element name="in-out-element-list" type="in-out-element-list-type" minOccurs="0" maxOccurs="1" />

<xs:element name="skeleton-list" type="skeleton-list-type" minOccurs="1" maxOccurs="1">

<xs:annotation>

<xs:documentation>A branch in which all the stages receive the minimum length of time needed to ensure the minimum green time required for all Signal Groups included in the branch (and of course all inter-green times required between conflicting Signal Groups)</xs:documentation>

</xs:annotation>

</xs:element>

<xs:element name="SGTP-list" type="SGTP-list-type" minOccurs="0" maxOccurs="1">

<xs:annotation>

<xs:documentation>SGTP – A detailed description of the operation of the signal as time proceeds (second by second), under predefined conditions</xs:documentation>

</xs:annotation>

</xs:element>

<xs:element name="macro-function-list" type="macro-function-list-type" minOccurs="0" maxOccurs="1" />

<xs:element name="action-logic-list" type="action-logic-list-type" minOccurs="0" maxOccurs="1" />

</xs:sequence>

<xs:attribute name="junction-schema-version" type="xs:string" fixed="1.0" use="required">

<xs:annotation>

<xs:documentation>XSD Schema version used to create file</xs:documentation>



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```
        </xs:annotation>
      </xs:attribute>
    </xs:complexType>
  </xs:element>
  <xs:complexType name="general-type">
    <xs:annotation>
      <xs:documentation>General junction information</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="project-name" type="xs:string" minOccurs="0" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>Name of project</xs:documentation>
        </xs:annotation>
      </xs:element>
      <xs:element name="junction-number" type="xs:string" minOccurs="1" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>
            Unique junction identifier for the project
          </xs:documentation>
        </xs:annotation>
      </xs:element>
      <xs:element name="junction-name" type="xs:string" minOccurs="0" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>
            Name of the junction
          </xs:documentation>
        </xs:annotation>
      </xs:element>
      <xs:element name="design-version" type="xs:string" minOccurs="0" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>Design version</xs:documentation>
        </xs:annotation>
      </xs:element>
      <xs:element name="designer-details" type="xs:string" minOccurs="0">
        <xs:annotation>
          <xs:documentation>
            String containing details about the designer
            like name, mail, phone etc
```



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```
            </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="customer-details" type="xs:string" minOccurs="0">
          <xs:annotation>
            <xs:documentation>
              String containing details about the customer
              like name, mail, phone etc
            </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="authority-details" type="xs:string" minOccurs="0" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>
              String containing details about the authority
              like name, mail, phone etc
            </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="junction-location" type="xs:string" minOccurs="0" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>TBD format for junction location</xs:documentation>
          </xs:annotation>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
    <xs:complexType name="revision-list-type">
      <xs:annotation>
        <xs:documentation>Configuration management - list of changes</xs:documentation>
      </xs:annotation>
      <xs:sequence>
        <xs:element name="revision" minOccurs="1" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="modifications" type="xs:string" minOccurs="0" maxOccurs="1">
                <xs:annotation>
                  <xs:documentation>Modification details</xs:documentation>
                </xs:annotation>
```



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```
            </xs:element>
          </xs:sequence>
          <xs:attribute name="version" type="xs:string" use="required">
            <xs:annotation>
              <xs:documentation>
                Document version
              </xs:documentation>
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="date" type="xs:string" use="required">
            <xs:annotation>
              <xs:documentation>
                Change date
              </xs:documentation>
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="planner-name" type="xs:string" use="required">
            <xs:annotation>
              <xs:documentation>
                Name of the person who made the change
              </xs:documentation>
            </xs:annotation>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="approach-list-type">
    <xs:sequence>
      <xs:element name="approach" minOccurs="1" maxOccurs="unbounded">
        <xs:annotation>
          <xs:documentation>List of junction's approach</xs:documentation>
        </xs:annotation>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="description" type="xs:string" minOccurs="0">
              <xs:annotation>
                <xs:documentation>Approach description</xs:documentation>
```



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```
                </xs:annotation>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="name" type="xs:string" use="required">
              <xs:annotation>
                <xs:documentation>Approach name</xs:documentation>
              </xs:annotation>
            </xs:attribute>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
    <xs:simpleType name="signal-type">
      <xs:restriction base="xs:string">
        <xs:enumeration value="red" />
        <xs:enumeration value="green" />
        <xs:enumeration value="yellow" />
        <xs:enumeration value="red-yellow" />
        <xs:enumeration value="flashing-red" />
        <xs:enumeration value="flashing-yellow" />
        <xs:enumeration value="flashing-green" />
        <xs:enumeration value="blank" />
      </xs:restriction>
    </xs:simpleType>
    <xs:complexType name="base-move-type">
      <xs:annotation>
        <xs:documentation>
          Defines the base move types allowed and their signal
          representation (light colors, sequences and durations)
        </xs:documentation>
      </xs:annotation>
      <xs:sequence>
        <xs:element name="active-signal" type="signal-type" minOccurs="1" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>the signal type representing the active period - i.e green for pedestrian
and flashing yellow for blinker</xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="inactive-signal" type="signal-type" minOccurs="1" maxOccurs="1">
```



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```
            <xs:annotation>
              <xs:documentation>the signal type representing the inactive period - i.e red for pedestrian and blank for blinker</xs:documentation>
            </xs:annotation>
          </xs:element>
          <xs:element name="activation-sequence" type="signal-sequence-type" minOccurs="0" maxOccurs="unbounded">
            <xs:annotation>
              <xs:documentation>The sequence to switch the signal from inactive to active - i.e 2 seconds of red-yellow for vehicles</xs:documentation>
            </xs:annotation>
          </xs:element>
          <xs:element name="deactivation-sequence" type="signal-sequence-type" minOccurs="0" maxOccurs="unbounded">
            <xs:annotation>
              <xs:documentation>The sequence to switch the signal from active to inactive - i.e 3 seconds of yellow for vehicles without flashing green</xs:documentation>
            </xs:annotation>
          </xs:element>
        </xs:sequence>
        <xs:attribute name="name" type="base-move-type-name" use="required">
          <xs:annotation>
            <xs:documentation>Name of the base type</xs:documentation>
          </xs:annotation>
        </xs:attribute>
      </xs:complexType>
      <xs:complexType name="move-list-type">
        <xs:annotation>
          <xs:documentation>Junctions specific moves list including move types and properties</xs:documentation>
        </xs:annotation>
        <xs:sequence>
          <xs:element name="move" minOccurs="1" maxOccurs="unbounded">
            <xs:annotation>
              <xs:documentation>List of junction moves</xs:documentation>
            </xs:annotation>
            <xs:complexType>
              <xs:attribute name="name" type="xs:string" use="required">
                <xs:annotation>
                  <xs:documentation>
                    move name
```



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```
                    </xs:documentation>
                </xs:annotation>
            </xs:attribute>
            <xs:attribute name="main-move" type="xs:boolean" use="optional">
                <xs:annotation>
                    <xs:documentation>true if move is considered a main move </xs:documentation>
                </xs:annotation>
            </xs:attribute>
            <xs:attribute name="base-move-type-name" type="base-move-type-name"
use="required">
                <xs:annotation>
                    <xs:documentation>
                                base move type - selected from defined
                                base-move-type
                    </xs:documentation>
                </xs:annotation>
            </xs:attribute>
            <xs:attribute name="min-duration" type="xs:integer" use="required">
                <xs:annotation>
                    <xs:documentation>
                                safety minimum move duration
                    </xs:documentation>
                </xs:annotation>
            </xs:attribute>
            <xs:attribute name="approach" type="xs:string" use="optional">
                <xs:annotation>
                    <xs:documentation>
                                Aproach this move is coming from
                    </xs:documentation>
                </xs:annotation>
            </xs:attribute>
            <xs:attribute name="lane-count" type="xs:integer" use="optional">
                <xs:annotation>
                    <xs:documentation>
                                Number of lanes in use by this move
                    </xs:documentation>
                </xs:annotation>
            </xs:attribute>
        </xs:complexType>
```



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```
        </xs:element>
      </xs:sequence>
    </xs:complexType>
    <xs:complexType name="stage-list-type">
      <xs:annotation>
        <xs:documentation>List of the junctions stages</xs:documentation>
      </xs:annotation>
      <xs:sequence>
        <xs:element name="stage" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="min-duration" type="xs:integer" minOccurs="1" maxOccurs="1">
                <xs:annotation>
                  <xs:documentation>
                    safety minimum duration
                  </xs:documentation>
                </xs:annotation>
              </xs:element>
              <xs:element name="stage-move-list" minOccurs="0" maxOccurs="1">
                <xs:annotation>
                  <xs:documentation>
                    list of active moves during stage
                  </xs:documentation>
                </xs:annotation>
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="move" type="xs:string" minOccurs="0"
maxOccurs="unbounded">
                      <xs:annotation>
                        <xs:documentation>
                          move name
                        </xs:documentation>
                      </xs:annotation>
                    </xs:element>
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="name" type="xs:string" use="required">
```



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```
            <xs:annotation>
              <xs:documentation>
                stage name
              </xs:documentation>
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="main-stage" type="xs:boolean" use="required">
            <xs:annotation>
              <xs:documentation>
                is it the main stage
              </xs:documentation>
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="power-on-stage" type="xs:boolean" use="optional">
            <xs:annotation>
              <xs:documentation>
                Is this stage the first one when the
                traffic light controller powers on - must be true for only one stage that is also a main
stage
              </xs:documentation>
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="program-switch-stage" type="xs:boolean" use="optional">
            <xs:annotation>
              <xs:documentation>Is switch between operating programs allowed at this stage
</xs:documentation>
            </xs:annotation>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="matrix-type">
    <xs:annotation>
      <xs:documentation>Inter-green matrix</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="element" maxOccurs="unbounded">
        <xs:annotation>
```



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```
        <xs:documentation>conflicting move pairs</xs:documentation>
      </xs:annotation>
      <xs:complexType>
        <xs:attribute name="move-in" type="xs:string" use="required">
          <xs:annotation>
            <xs:documentation>entering move</xs:documentation>
          </xs:annotation>
        </xs:attribute>
        <xs:attribute name="move-out" type="xs:string" use="required">
          <xs:annotation>
            <xs:documentation>exiting move</xs:documentation>
          </xs:annotation>
        </xs:attribute>
        <xs:attribute name="value" type="xs:integer" use="required">
          <xs:annotation>
            <xs:documentation>inter-green time in full seconds </xs:documentation>
          </xs:annotation>
        </xs:attribute>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="inter-stage-list-type">
  <xs:annotation>
    <xs:documentation>Inter-stage list and description</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="inter-stage" minOccurs="0" maxOccurs="unbounded">
      <xs:annotation>
        <xs:documentation>list of defined inter-stages</xs:documentation>
      </xs:annotation>
      <xs:complexType>
        <xs:sequence>
          <xs:element name="duration" type="xs:integer">
            <xs:annotation>
              <xs:documentation>Inter-stage duration in seconds</xs:documentation>
            </xs:annotation>
          </xs:element>
```



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```
<xs:element name="isg-move-list">
  <xs:annotation>
    <xs:documentation>moves participating in inter-stage in/out
times</xs:documentation>
  </xs:annotation>
  <xs:complexType>
    <xs:sequence>
      <xs:element name="move" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
          <xs:attribute name="name" type="xs:string" use="required">
            <xs:annotation>
              <xs:documentation>The move name</xs:documentation>
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="type" use="required">
            <xs:annotation>
              <xs:documentation>move action in inter-stage (in = entering, out=ending,
in-out=entering and ending within interstge)</xs:documentation>
            </xs:annotation>
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:enumeration value="in" />
                <xs:enumeration value="out" />
                <xs:enumeration value="in-out" />
                <xs:enumeration value="continuous" />
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
          <xs:attribute name="second">
            <xs:annotation>
              <xs:documentation>
                action second
                within the
                inter-stage -
                starting from
                second zero up
                to length of the
                inter-stage -
                i.e move 3 is
```



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```
                ending at second
                3
              </xs:documentation>
            </xs:annotation>
            <xs:simpleType>
              <xs:restriction base="xs:integer">
                <xs:minInclusive value="0" />
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
          <xs:attribute name="duration">
            <xs:annotation>
              <xs:documentation>
                Optional length
                of in-out type
                moves
              </xs:documentation>
            </xs:annotation>
            <xs:simpleType>
              <xs:restriction base="xs:integer">
                <xs:minInclusive value="0" />
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
          <xs:attribute name="partial-group-name" type="xs:string">
            <xs:annotation>
              <xs:documentation>Optional group name for partial interstages (also
called parallel stages ) - use to group moves within the interstage</xs:documentation>
            </xs:annotation>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:element>
</xs:sequence>
<xs:attribute name="stage-in" type="xs:string" use="required">
  <xs:annotation>
    <xs:documentation>Entering stage name</xs:documentation>
```



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```
            </xs:annotation>
          </xs:attribute>
          <xs:attribute name="stage-out" type="xs:string" use="required">
            <xs:annotation>
              <xs:documentation>Ending stage name</xs:documentation>
            </xs:annotation>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="parameter-list-type">
    <xs:annotation>
      <xs:documentation>Parameter list - parameters that can exposed externally - i.e traffic control
system</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="parameter" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="description" type="xs:string" minOccurs="0">
              <xs:annotation>
                <xs:documentation>
                  Description
                </xs:documentation>
              </xs:annotation>
            </xs:element>
            <xs:element name="tcs-name" type="xs:string" minOccurs="0" maxOccurs="1">
              <xs:annotation>
                <xs:documentation>Name of this parameter at the traffic control center
(TCS)</xs:documentation>
              </xs:annotation>
            </xs:element>
            <xs:element name="tcs-number" type="xs:string" minOccurs="0" maxOccurs="1">
              <xs:annotation>
                <xs:documentation>Number of this parameter at the traffic control center
(TCS)</xs:documentation>
              </xs:annotation>
            </xs:element>
```



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```
<xs:element name="alias" type="xs:string" minOccurs="0">
  <xs:annotation>
    <xs:documentation>
      Optional - Alias to other parameter
    </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="program" minOccurs="0" maxOccurs="unbounded">
  <xs:annotation>
    <xs:documentation>
      Parameter value in different programs
    </xs:documentation>
  </xs:annotation>
  <xs:complexType>
    <xs:attribute name="number" type="xs:integer" use="required">
      <xs:annotation>
        <xs:documentation>
          Program number
        </xs:documentation>
      </xs:annotation>
    </xs:attribute>
    <xs:attribute name="value" type="xs:integer" use="required">
      <xs:annotation>
        <xs:documentation>
          parameter value
        </xs:documentation>
      </xs:annotation>
    </xs:attribute>
  </xs:complexType>
</xs:element>
</xs:sequence>
<xs:attribute name="name" type="xs:string" use="required">
  <xs:annotation>
    <xs:documentation>Parameter name</xs:documentation>
  </xs:annotation>
</xs:attribute>
</xs:complexType>
</xs:element>
```



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```
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="in-out-element-list-type">
    <xs:annotation>
      <xs:documentation>list of pulses and detectors outgoing/incoming from/to junction and their properties</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="element" minOccurs="0" maxOccurs="unbounded">
        <xs:annotation>
          <xs:documentation>Input and outputs elements = detectors and pulses</xs:documentation>
        </xs:annotation>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="description" type="xs:string" minOccurs="0">
              <xs:annotation>
                <xs:documentation>
                  Optional description
                </xs:documentation>
              </xs:annotation>
            </xs:element>
            <xs:element name="related-moves">
              <xs:annotation>
                <xs:documentation>
                  Optional - a list of moves related
                  to this detector or pulse. for
                  pedestrian push button Pab - related
                  moves will be a and b. for blinker
                  Bh related move can be 2 - the
                  vehicle move that is conflicting
                  with crossing h
                </xs:documentation>
              </xs:annotation>
              <xs:complexType>
                <xs:sequence>
                  <xs:element name="move" minOccurs="0" maxOccurs="unbounded">
                    <xs:complexType>
                      <xs:attribute name="name" type="xs:string" use="required" />
                    </xs:complexType>
```



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```
                    </xs:element>
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:sequence>
            <xs:attribute name="name" type="xs:string" use="required">
              <xs:annotation>
                <xs:documentation>Element name</xs:documentation>
              </xs:annotation>
            </xs:attribute>
            <xs:attribute name="type" type="in-out-element-type" use="required">
              <xs:annotation>
                <xs:documentation>Element type from selection list , i.e vehicle demand detector
</xs:documentation>
              </xs:annotation>
            </xs:attribute>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
    <xs:complexType name="program-list-type">
      <xs:annotation>
        <xs:documentation>Operating programs description and attributes</xs:documentation>
      </xs:annotation>
      <xs:sequence>
        <xs:element name="program" minOccurs="1" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1">
                <xs:annotation>
                  <xs:documentation>free text</xs:documentation>
                </xs:annotation>
              </xs:element>
              <xs:element name="comment" type="xs:string" minOccurs="0" maxOccurs="1">
                <xs:annotation>
                  <xs:documentation>free text</xs:documentation>
                </xs:annotation>
              </xs:element>
            </xs:sequence>
```



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```
            <xs:attribute name="number" type="xs:integer" use="required">
              <xs:annotation>
                <xs:documentation>Program number</xs:documentation>
              </xs:annotation>
            </xs:attribute>
            <xs:attribute name="fixed-cycle" type="xs:boolean" use="required">
              <xs:annotation>
                <xs:documentation>set to true if program is fixed cycle type</xs:documentation>
              </xs:annotation>
            </xs:attribute>
            <xs:attribute name="fixed-cycle-length" type="xs:integer" use="optional">
              <xs:annotation>
                <xs:documentation>length of cycle in case of fixed cycle</xs:documentation>
              </xs:annotation>
            </xs:attribute>
            <xs:attribute name="fixed-cycle-offset" type="xs:integer" use="optional">
              <xs:annotation>
                <xs:documentation>offset of junction related to master junction in case of green-wave
</xs:documentation>
              </xs:annotation>
            </xs:attribute>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
    <xs:complexType name="program-schedule-type">
      <xs:annotation>
        <xs:documentation>Programs operating schedule (i.e morning program from 7am-9am
etc)</xs:documentation>
      </xs:annotation>
      <xs:sequence>
        <xs:element name="group" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="element" minOccurs="0" maxOccurs="unbounded">
                <xs:complexType>
                  <xs:attribute name="start" use="required">
                    <xs:annotation>
                      <xs:documentation>
```



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```
                    Program start time in minutes
                    from midnight - i.e
                    6am will be represented by
                    360
                  </xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                  <xs:restriction base="xs:integer">
                    <xs:minInclusive value="0" />
                    <xs:maxInclusive value="1440" />
                  </xs:restriction>
                </xs:simpleType>
              </xs:attribute>
              <xs:attribute name="duration" use="required">
                <xs:annotation>
                  <xs:documentation>
                    program duration (in minutes)
                  </xs:documentation>
                </xs:annotation>
                <xs:simpleType>
                  <xs:restriction base="xs:integer">
                    <xs:minInclusive value="0" />
                    <xs:maxInclusive value="1440" />
                  </xs:restriction>
                </xs:simpleType>
              </xs:attribute>
              <xs:attribute name="program" type="xs:integer" use="required">
                <xs:annotation>
                  <xs:documentation>program number to activate during this
time</xs:documentation>
                </xs:annotation>
              </xs:attribute>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
        <xs:attribute name="name" type="xs:string" use="required">
          <xs:annotation>
            <xs:documentation>Schedule group description (i.e Sunday-
Thursday)</xs:documentation>
```



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```
            </xs:annotation>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="SGTP-list-type">
    <xs:annotation>
      <xs:documentation>Signal Group Timing Plan  (maximum, minimum etc)</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="SGTP" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="comment" type="xs:string">
              <xs:annotation>
                <xs:documentation>
                                        General comment
                                    </xs:documentation>
              </xs:annotation>
            </xs:element>
            <xs:element name="stage-list">
              <xs:annotation>
                <xs:documentation>
                                        List of stage and their duration in
                                        time plan
                                    </xs:documentation>
              </xs:annotation>
              <xs:complexType>
                <xs:sequence>
                  <xs:element name="stage" minOccurs="0" maxOccurs="unbounded">
                    <xs:complexType>
                      <xs:attribute name="name" type="xs:string" use="required">
                        <xs:annotation>
                          <xs:documentation>
                                                                    stage name
                                                                </xs:documentation>
                        </xs:annotation>
```



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```
                    </xs:attribute>
                    <xs:attribute name="duration" type="xs:integer" use="required">
                      <xs:annotation>
                        <xs:documentation>
                                                                                    stage
duration
                                                                                </xs:documentation>
                      </xs:annotation>
                    </xs:attribute>
                  </xs:complexType>
                </xs:element>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
          <xs:element name="element-list">
            <xs:annotation>
              <xs:documentation>
                                    List of input/output elements timing
                                    information - i.e demand detector
                                    check point, extension detector
                                    check range etc
                            </xs:documentation>
            </xs:annotation>
            <xs:complexType>
              <xs:annotation>
                <xs:documentation>
                                            i.e demand detector check point,
                                            extension detector check range
                                    </xs:documentation>
              </xs:annotation>
              <xs:sequence>
                <xs:element name="element" minOccurs="0" maxOccurs="unbounded">
                  <xs:complexType>
                    <xs:attribute name="name" type="xs:string" use="required">
                      <xs:annotation>
                        <xs:documentation>
                                                                                    Element
name
```



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(detector, pulse etc)
</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="start" type="xs:integer" use="required">
<xs:annotation>
<xs:documentation>
start time
</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="duration" type="xs:integer" use="required">
<xs:annotation>
<xs:documentation>
Duration
</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="active" type="xs:boolean" use="required">
<xs:annotation>
<xs:documentation>
Specifies whether element should be considered active in order to take effect
</xs:documentation>
</xs:annotation>
</xs:attribute>
</xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>
</xs:element>



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```
<xs:element name="isg-partial-group-offset-list" type="isg-partial-group-offset-list-type" minOccurs="0" maxOccurs="1">
<xs:annotation>
<xs:documentation>
Define offset of move groups within
parallel interstages type
inter-stage
</xs:documentation>
</xs:annotation>
</xs:element>
<xs:element name="independent-move-list" type="independent-move-list-type" minOccurs="0" maxOccurs="1">
<xs:annotation>
<xs:documentation>list of moves that are not part of any stage or inter-stage and their start time and duration in time plan</xs:documentation>
</xs:annotation>
</xs:element>
</xs:sequence>
<xs:attribute name="name" type="xs:string" use="required">
<xs:annotation>
<xs:documentation>Time plan name</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="skeleton" type="xs:integer" use="required">
<xs:annotation>
<xs:documentation>Skeleton number this time-plan is based on</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="main-stage-end-second" type="xs:integer" use="required">
<xs:annotation>
<xs:documentation>the second in cycle of the main stage ending - used to display main stage ending at the same second in all time plans</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="program" type="xs:integer" use="optional">
<xs:annotation>
<xs:documentation>the program this time plan is attached to</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="cycle-length" type="xs:integer" use="required">
```



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```
            <xs:annotation>
              <xs:documentation>The cycle length of this time plan</xs:documentation>
            </xs:annotation>
          </xs:attribute>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="skeleton-list-type">
    <xs:annotation>
      <xs:documentation>Skeletons</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="skeleton" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="stage-list" minOccurs="1" maxOccurs="1">
              <xs:annotation>
                <xs:documentation>A list of stages that make the skeleton, starting and ending with a
main stage</xs:documentation>
              </xs:annotation>
              <xs:complexType>
                <xs:sequence>
                  <xs:element name="stage" minOccurs="0" maxOccurs="unbounded">
                    <xs:complexType>
                      <xs:attribute name="name" type="xs:string" use="required">
                        <xs:annotation>
                          <xs:documentation>stage name</xs:documentation>
                        </xs:annotation>
                      </xs:attribute>
                      <xs:attribute name="duration" type="xs:integer" use="required">
                        <xs:annotation>
                          <xs:documentation>stage duration</xs:documentation>
                        </xs:annotation>
                      </xs:attribute>
                    </xs:complexType>
                  </xs:element>
                </xs:sequence>
              </xs:complexType>
```



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```
            </xs:element>
            <xs:element name="element-list" minOccurs="0">
              <xs:annotation>
                <xs:documentation>List of input/output elements timing information
</xs:documentation>
              </xs:annotation>
              <xs:complexType>
                <xs:sequence>
                  <xs:element name="element" minOccurs="0" maxOccurs="unbounded">
                    <xs:complexType>
                      <xs:attribute name="name" type="xs:string" use="required">
                        <xs:annotation>
                          <xs:documentation>Element name (detector, pulse
etc)</xs:documentation>
                        </xs:annotation>
                      </xs:attribute>
                      <xs:attribute name="start" type="xs:integer" use="required">
                        <xs:annotation>
                          <xs:documentation>start time in seconds</xs:documentation>
                        </xs:annotation>
                      </xs:attribute>
                      <xs:attribute name="duration" type="xs:integer" use="required">
                        <xs:annotation>
                          <xs:documentation>Duration in seconds</xs:documentation>
                        </xs:annotation>
                      </xs:attribute>
                      <xs:attribute name="active" type="xs:boolean" use="required">
                        <xs:annotation>
                          <xs:documentation>Specifies whether element sent a signal or didn't
</xs:documentation>
                        </xs:annotation>
                      </xs:attribute>
                    </xs:complexType>
                  </xs:element>
                </xs:sequence>
              </xs:complexType>
            </xs:element>
            <xs:element name="isg-partial-group-offset-list" type="isg-partial-group-offset-list-type"
minOccurs="0" maxOccurs="1">
              <xs:annotation>
```



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<xs:documentation>Define offset of move groups within parallel interstages type inter-stage </xs:documentation>

</xs:annotation>

</xs:element>

<xs:element name="independent-move-list" type="independent-move-list-type" minOccurs="0" maxOccurs="1">

<xs:annotation>

<xs:documentation>list of moves that are not part of any stage or inter-stage and their start time and duration in time plan</xs:documentation>

</xs:annotation>

</xs:element>

</xs:sequence>

<xs:attribute name="number" type="xs:decimal" use="required">

<xs:annotation>

<xs:documentation>The number of the skeleton</xs:documentation>

</xs:annotation>

</xs:attribute>

<xs:attribute name="is-allowed" type="xs:boolean" use="required">

<xs:annotation>

<xs:documentation>If true, specifies that this skeleton is allowed. This is used to mask out known skeletons that although can be calculated from stage flow - they are not allowed because of logics</xs:documentation>

</xs:annotation>

</xs:attribute>

<xs:attribute name="cycle-length" type="xs:integer" use="required">

<xs:annotation>

<xs:documentation>Cycle length of the skeleton</xs:documentation>

</xs:annotation>

</xs:attribute>

</xs:complexType>

</xs:element>

</xs:sequence>

</xs:complexType>

<xs:simpleType name="turn-type">

<xs:restriction base="xs:string">

<xs:enumeration value="n/a" />

<xs:enumeration value="left" />

<xs:enumeration value="right" />

<xs:enumeration value="straight" />

<xs:enumeration value="u-turn" />



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```
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="evacuation-information-type">
    <xs:annotation>
      <xs:documentation>Evacuation information for calculating inter-green
times</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="pedestrian-information-list" minOccurs="0" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>Specific properties required for inter-green calculation regarding
pedestrian moves</xs:documentation>
        </xs:annotation>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="pedestrian-information" minOccurs="0" maxOccurs="unbounded">
              <xs:complexType>
                <xs:attribute name="move" type="xs:string" use="required">
                  <xs:annotation>
                    <xs:documentation>pedestrian move name</xs:documentation>
                  </xs:annotation>
                </xs:attribute>
                <xs:attribute name="speed" type="xs:double" use="required" />
              </xs:complexType>
            </xs:element>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="vehicle-information-list" minOccurs="0" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>Specific properties reqiured for inter-green calculation regarding
vehicle moves</xs:documentation>
        </xs:annotation>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="vehicle-information" minOccurs="0" maxOccurs="unbounded">
              <xs:complexType>
                <xs:attribute name="move" type="xs:string" use="required">
                  <xs:annotation>
```



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```
            <xs:documentation>move name</xs:documentation>
          </xs:annotation>
        </xs:attribute>
        <xs:attribute name="turn" type="turn-type" use="required" />
        <xs:attribute name="fast-vehicle-entry-speed" use="required">
          <xs:simpleType>
            <xs:restriction base="xs:int">
              <xs:minInclusive value="0" />
              <xs:maxInclusive value="100" />
            </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="slow-vehicle-exit-speed" use="required">
          <xs:simpleType>
            <xs:restriction base="xs:int">
              <xs:minInclusive value="0" />
              <xs:maxInclusive value="100" />
            </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="fast-vehicle-exit-speed" use="required">
          <xs:simpleType>
            <xs:restriction base="xs:int">
              <xs:minInclusive value="0" />
              <xs:maxInclusive value="100" />
            </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="vehicle-deceleration" type="xs:double" />
        <xs:attribute name="vehicle-length" type="xs:double" />
      </xs:complexType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="pt-information-list" minOccurs="0" maxOccurs="1">
  <xs:annotation>
    <xs:documentation>Specific properties reqiured for inter-green calculation regarding PT
moves</xs:documentation>
```



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```
        </xs:annotation>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="pt-information" minOccurs="0" maxOccurs="unbounded">
              <xs:complexType>
                <xs:attribute name="move" type="xs:string" use="required">
                  <xs:annotation>
                    <xs:documentation>move name</xs:documentation>
                  </xs:annotation>
                </xs:attribute>
                <xs:attribute name="turn" type="turn-type" use="required" />
                <xs:attribute name="service-accl" type="xs:double" />
                <xs:attribute name="service-decl" type="xs:double" />
                <xs:attribute name="emergency-accl" type="xs:double" />
                <xs:attribute name="emergency-decl" type="xs:double" />
                <xs:attribute name="vehicle-length" type="xs:double" />
              </xs:complexType>
            </xs:element>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="calculation-data-list" minOccurs="1" maxOccurs="1">
        <xs:annotation>
          <xs:documentation>move pairs evacuation distances and results of inter-green time
calculated</xs:documentation>
        </xs:annotation>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="calculation-data" minOccurs="0" maxOccurs="unbounded">
              <xs:annotation>
                <xs:documentation>move pairs evacuation distances and results of inter-green time
calculated</xs:documentation>
              </xs:annotation>
              <xs:complexType>
                <xs:attribute name="move-in" type="xs:string" use="required">
                  <xs:annotation>
                    <xs:documentation>Entering move</xs:documentation>
                  </xs:annotation>
                </xs:attribute>
```



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```
                    <xs:attribute name="turn-in" type="turn-type" use="required" />
                    <xs:attribute name="move-out" type="xs:string" use="required">
                      <xs:annotation>
                        <xs:documentation>Evacuating move</xs:documentation>
                      </xs:annotation>
                    </xs:attribute>
                    <xs:attribute name="turn-out" type="turn-type" use="required" />
                    <xs:attribute name="exit-distance" type="xs:double" use="required">
                      <xs:annotation>
                        <xs:documentation>Exit move distance to conflict area (crossing ped length in
case of pedestrian)</xs:documentation>
                      </xs:annotation>
                    </xs:attribute>
                    <xs:attribute name="entry-distance" type="xs:double" use="required">
                      <xs:annotation>
                        <xs:documentation>Entering move distance to conflict area (0 in case of
pedestrian)</xs:documentation>
                      </xs:annotation>
                    </xs:attribute>
                    <xs:attribute name="calculated-inter-green-time" type="xs:double" use="required">
                      <xs:annotation>
                        <xs:documentation>raw calculation results</xs:documentation>
                      </xs:annotation>
                    </xs:attribute>
                    <xs:attribute name="result-inter-green-time" type="xs:integer" use="required">
                      <xs:annotation>
                        <xs:documentation>rounded calculation results</xs:documentation>
                      </xs:annotation>
                    </xs:attribute>
                  </xs:complexType>
                </xs:element>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
        <xs:attribute name="calculation-formula" type="intergreen-calculation-formula-type"
use="required">
          <xs:annotation>
            <xs:documentation>inter-green calculation method - select from supported
list</xs:documentation>
```



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```
      </xs:annotation>
    </xs:attribute>
  </xs:complexType>
  <xs:complexType name="traffic-volume-list-type">
    <xs:annotation>
      <xs:documentation>Traffic volume list</xs:documentation>
    </xs:annotation>
    <xs:sequence>
      <xs:element name="traffic-volume" minOccurs="0" maxOccurs="unbounded">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="program" minOccurs="1" maxOccurs="unbounded">
              <xs:annotation>
                <xs:documentation>Traffic volume for different programs</xs:documentation>
              </xs:annotation>
              <xs:complexType>
                <xs:attribute name="number" type="xs:integer" use="required">
                  <xs:annotation>
                    <xs:documentation>Program number</xs:documentation>
                  </xs:annotation>
                </xs:attribute>
                <xs:attribute name="value" type="xs:integer" use="required">
                  <xs:annotation>
                    <xs:documentation>Volume</xs:documentation>
                  </xs:annotation>
                </xs:attribute>
                <xs:attribute name="move" type="xs:string" use="required">
                  <xs:annotation>
                    <xs:documentation>Move nmae</xs:documentation>
                  </xs:annotation>
                </xs:attribute>
              </xs:complexType>
            </xs:element>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
```



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```
<xs:complexType name="isg-partial-group-offset-list-type">
  <xs:annotation>
    <xs:documentation>Define offset of move groups within parallel interstages type inter-
stage</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="isg-partial-group-offset" minOccurs="0" maxOccurs="unbounded">
      <xs:complexType>
        <xs:attribute name="partial-group-name" type="xs:string" use="required">
          <xs:annotation>
            <xs:documentation>Group name</xs:documentation>
          </xs:annotation>
        </xs:attribute>
        <xs:attribute name="partial-group-offset" type="xs:integer" use="required">
          <xs:annotation>
            <xs:documentation>Offset in seconds</xs:documentation>
          </xs:annotation>
        </xs:attribute>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="signal-sequence-type">
  <xs:annotation>
    <xs:documentation>defines a unique signal sequence</xs:documentation>
  </xs:annotation>
  <xs:attribute name="duration" type="xs:int" use="required">
    <xs:annotation>
      <xs:documentation>duration of signal in seconds</xs:documentation>
    </xs:annotation>
  </xs:attribute>
  <xs:attribute name="signal-type" type="signal-type" use="required">
    <xs:annotation>
      <xs:documentation>type of signal - i.e red-yellow</xs:documentation>
    </xs:annotation>
  </xs:attribute>
  <xs:attribute name="considered-active" type="xs:boolean" use="required">
    <xs:annotation>
```



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```
            <xs:documentation>determines if during this sequence the signal is considered active - i.e for flashing green it will be true - for red-yellow it will be false </xs:documentation>
          </xs:annotation>
        </xs:attribute>
      </xs:complexType>
      <xs:simpleType name="base-move-type-name">
        <xs:restriction base="xs:string">
          <xs:enumeration value="vehicle" />
          <xs:enumeration value="pedestrian" />
          <xs:enumeration value="public-transport" />
          <xs:enumeration value="yellow-blinker" />
          <xs:enumeration value="bicycles" />
          <xs:enumeration value="preemption-triangle" />
          <xs:enumeration value="vehicle-flashing-green" />
        </xs:restriction>
      </xs:simpleType>
      <xs:simpleType name="in-out-element-type">
        <xs:restriction base="xs:string">
          <xs:enumeration value="vehicle-detector-demand" />
          <xs:enumeration value="vehicle-detector-extension" />
          <xs:enumeration value="vehicle-detector-queue" />
          <xs:enumeration value="pedestrian-detector-push-button" />
          <xs:enumeration value="pulse-out" />
          <xs:enumeration value="pulse-in" />
          <xs:enumeration value="pulse-sync" />
          <xs:enumeration value="pulse-general" />
          <xs:enumeration value="pulse-internal" />
          <xs:enumeration value="pulse-failure" />
          <xs:enumeration value="pt-detector-location-far" />
          <xs:enumeration value="pt-detector-location-near" />
          <xs:enumeration value="pt-detector-location-dilemma" />
          <xs:enumeration value="pt-detector-location-stopline" />
          <xs:enumeration value="pt-detector-location-cancelation" />
          <xs:enumeration value="pt-detector-location-emergency" />
        </xs:restriction>
      </xs:simpleType>
      <xs:simpleType name="action-base-type">
        <xs:restriction base="xs:string">
          <xs:enumeration value="switch-to-stage" />
```



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```
        <xs:enumeration value="activate-pulse" />
        <xs:enumeration value="deactivate-pulse" />
        <xs:enumeration value="activate-move" />
        <xs:enumeration value="deactivate-move" />
        <xs:enumeration value="initiate-partial-isg" />
        <xs:enumeration value="switch-to-special-stage" />
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="when-base-type">
      <xs:restriction base="xs:string">
        <xs:enumeration value="during-stage" />
        <xs:enumeration value="during-move" />
        <xs:enumeration value="every-second" />
      </xs:restriction>
    </xs:simpleType>
    <xs:complexType name="action-logic-type">
      <xs:sequence>
        <xs:element name="true-action" type="action-type" minOccurs="1" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>
                                    type of the action performed if boolean
                                    condition is true
                                </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="false-action" type="action-type" minOccurs="0" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>type of the action performed if boolean condition is
false</xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="when" type="when-type" minOccurs="1" maxOccurs="1">
          <xs:annotation>
            <xs:documentation>
                                    when the condition is checked
                                </xs:documentation>
          </xs:annotation>
        </xs:element>
        <xs:element name="boolean-condition" type="xs:string" minOccurs="1" maxOccurs="1">
```



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```
            <xs:annotation>
              <xs:documentation>
                                condition that is evaluates to true the action
                                will be executed - i.e GetMoveCurrentRed(6) =
                                pMaxRed_6
                        </xs:documentation>
            </xs:annotation>
          </xs:element>
          <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1">
            <xs:annotation>
              <xs:documentation>documentation</xs:documentation>
            </xs:annotation>
          </xs:element>
        </xs:sequence>
      </xs:complexType>
      <xs:complexType name="action-type">
        <xs:attribute name="action-base-type" type="action-base-type" use="required">
          <xs:annotation>
            <xs:documentation>The actual action taken if condition evaluates to true
</xs:documentation>
          </xs:annotation>
        </xs:attribute>
        <xs:attribute name="related-component" type="xs:string" use="optional">
          <xs:annotation>
            <xs:documentation>The stage or move or pulse the action is performed on
</xs:documentation>
          </xs:annotation>
        </xs:attribute>
      </xs:complexType>
      <xs:complexType name="when-type">
        <xs:annotation>
          <xs:documentation>Action logic when type</xs:documentation>
        </xs:annotation>
        <xs:attribute name="when-base-type" type="when-base-type" use="required">
          <xs:annotation>
            <xs:documentation>when the condition is checked. i.e every second or during stage "related-
component"</xs:documentation>
          </xs:annotation>
        </xs:attribute>
```



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```
<xs:attribute name="related-component" type="xs:string" use="optional">
  <xs:annotation>
    <xs:documentation>The stage or move the referred to in the when base type - optional since it is not required on when = every-second </xs:documentation>
  </xs:annotation>
</xs:attribute>
</xs:complexType>
<xs:complexType name="base-move-list-type">
  <xs:annotation>
    <xs:documentation>Describes the base signal characteristics, for example for vehicle move the inactive signal is red and the active signal is green,
activation sequence include 2 seconds of red-yellow and deactivation sequence may include 3 seconds of flashing green and 3 seconds of yellow.
since in this example the 3 seconds of flashing green is considered green for inter-green calculation than the attribute consider-active is set to true </xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="base-move" type="base-move-type" minOccurs="1" maxOccurs="unbounded" />
  </xs:sequence>
</xs:complexType>
<xs:complexType name="action-logic-list-type">
  <xs:annotation>
    <xs:documentation>list of action logic</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="action-logic" type="action-logic-type" minOccurs="1" maxOccurs="unbounded" />
  </xs:sequence>
</xs:complexType>
<xs:simpleType name="intergreen-calculation-formula-type">
  <xs:restriction base="xs:string">
    <xs:enumeration value="israel-mot-1981-v1" />
  </xs:restriction>
</xs:simpleType>
<xs:complexType name="macro-function-type">
  <xs:sequence>
    <xs:element name="macro-logic" type="xs:string" minOccurs="1" maxOccurs="1">
      <xs:annotation>
        <xs:documentation>
                                The logic of the macro function
```



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```
                                    </xs:documentation>
                                </xs:annotation>
                            </xs:element>
                            <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1">
                                <xs:annotation>
                                    <xs:documentation>Documentation</xs:documentation>
                                </xs:annotation>
                            </xs:element>
                        </xs:sequence>
                        <xs:attribute name="macro-name" type="xs:string" use="required">
                            <xs:annotation>
                                <xs:documentation>Name of the macro function</xs:documentation>
                            </xs:annotation>
                        </xs:attribute>
                    </xs:complexType>
                    <xs:complexType name="macro-function-list-type">
                        <xs:sequence>
                            <xs:element name="macro-function" type="macro-function-type" minOccurs="1"
maxOccurs="unbounded">
                                <xs:annotation>
                                    <xs:documentation>List of macro function to be used in action logic - macro function must
return a boolean value (true/falase), currently parameters to macro are not
supported</xs:documentation>
                                </xs:annotation>
                            </xs:element>
                        </xs:sequence>
                    </xs:complexType>
                    <xs:complexType name="independent-move-list-type">
                        <xs:sequence>
                            <xs:element name="independent-move" type="independent-move-type" minOccurs="1"
maxOccurs="unbounded" />
                        </xs:sequence>
                    </xs:complexType>
                    <xs:complexType name="independent-move-type">
                        <xs:annotation>
                            <xs:documentation>description of move start time and duration</xs:documentation>
                        </xs:annotation>
                        <xs:attribute name="name" type="xs:string" use="required">
                            <xs:annotation>
                                <xs:documentation>
```



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```
                                    move name
                </xs:documentation>
            </xs:annotation>
        </xs:attribute>
        <xs:attribute name="start-second" type="xs:int" use="required">
            <xs:annotation>
                <xs:documentation>The second in the cycle the move starts</xs:documentation>
            </xs:annotation>
        </xs:attribute>
        <xs:attribute name="duration" type="xs:int">
            <xs:annotation>
                <xs:documentation>duration of moves in seconds</xs:documentation>
            </xs:annotation>
        </xs:attribute>
    </xs:complexType>
</xs:schema>
```



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# Appendix 4 – DVI35 protocol type A

- This document is intended to give information about the meaning of the bytes in each identifier structure and not beyond.
- The structure of the protocol is based on the standard IEC 870-5-2.

**Each command has an ID number that indicates the type of message and its data according to the following details:**

**From host computer to traffic light controller (TLC)**

ID1 A status command for a controller that defines how to monitor its operation and maintain control over it.

ID4 Changing data in the controller: for example, plan parameters (cycle minimum & maximum length, phase minimum & maximum length), setting OUTPUT to work in the same program, etc. (20 programs * 5 blocks per program)

ID5 Changing the GAP TIME for the detectors (extension unit), Set TLC real time Clock, clear Journal.

ID6 Set detectors interval for collecting data.

**From TLS to host computer:**

ID10 General data on the state of the TLC at this moment (plan number, time in the cycle, status of the light bulb, etc.).

D11 Receiving the journal/event log (about the last 200 events recorded by the controller).

ID14 Receiving data from the controller (see ID4).

ID15 Receiving the GAP TIME of the detectors (extension unit) (see ID5).

ID16 Receiving the traffic data of the detectors recorded in the TLC's memory.



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Basic command (message) structure:

| | Byte | Details and remarks |
|---|---|---|
| 1 | 0x68 | Beginning of command |
| 2 | Number of data bytes | The number of bytes from command byte up to the byte before the check sum byte. |
| 3 | Number of data bytes | The number of bytes from command byte up to the byte before the check sum byte. |
| 4 | 0x68 | End of header |
| 5 | Command | As described below according to the IEC 870-5-2 |
| 6 | Address from TLC | As defined by the TLC |
| 7 | Address | Always 0 |
| 8 | Address | Always 0 |
| 9 | Address | Always 0 |
| 10 | ID = 1 | Command ID |
| 11 | Program 0 .. 16 | Plan Number |
| 12 | Impulse | Data according to the Command ID |
| 13 | Status | Data according to the Command ID |
| 14 | Request | Data according to the Command ID |
| 15 | Status2 | Data according to the Command ID |
| 16 | Status3 | Data according to the Command ID |
| 17 | Check sum | Check sum of all bytes from Command field till byte before check sum |
| 18 | 0x16 | End of mesage |



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1. The COMMAND structure (byte 5 of the message) is explained in the IEC 870-5-2 standard document; an explanation can be found there in section 4.2.4 4.2.3. Use of fixed bytes:

| | | |
|---|---|---|
| &H9 | Request status of link | (hand check - short telegram) |
| &H0 | Reset remote link | (hand check - short telegram) |
| &H43 | long telegram | |
| &H4b | short telegram | |

2. Initialization of the DVI35 protocol and start communication

**Protocol Initialization:**

Xmit: ->> 10 09 01 0A 16

Rcx : <<- 00 00 10 0B 01 0C 16 00

**Protocol Initialization**

Xmit: ->> 10 00 01 01 16

Rcx : <<- 00 00 10 0B 01 0C 16 00 00 00 E5 00

**Sending ID1**

Xmit: ->> 00 00 68 0C 0C 68 43 01 00 00 00 01 01 00 01 00 00 00 47 16 00

Rcx : <<- 00 00 E5 00

**Sending short telegram**

Xmit: ->> 00 00 10 4B 01 4C 16 00

**recieving ID10**

Rcx : <<- 00 00 68 37 37 68 08 01 00 00 01 0A 01 50 2B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 11 41 14 41 44 11 1E 4B 00 00 00 00 00 00 00 00 00 00 00 00 60 00 00 00 00 69 16 00

**Sending short telegram**

Xmit: ->> 00 00 10 4B 01 4C 16 00

**Receive E5 (No new data)**

Rcx : <- 00 00 E5 00

3. Controller address: the address range is 1 – 255
4. Checksum calculation – add together all the data bytes from byte 5 and as a result keeping only the lowest byte (least significant byte)
5. The TLC's response to commands (E5, ID10, etc.) takes about 100 ms. If we add the response length (ID10 = ~70 ms) + a safety margin, the waiting time for the controller's answer should be set to 250 ms.



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ID1:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 1 | |
| 11 | Program 0 .. 16 | Traffic light Timing plan number 1-16 Data block 2.<br>Traffic light Timing plan number 17-32 Data block 2 |
| 12 | Impulse | Synchronization pulse |
| 13 | Status | Set working mode |
| 14 | Request | Data request |
| 15 | Status2 | For future use |
| 16 | Status3 | For future use |
| 17 | Check | |
| 18 | 0x16 | |



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Impulse

Bit 0 -> SY – Master Signalized Intersection

Bit 1 -> FO - Master Signalized Intersection (not in use)

Bit 2 -> SY – Secondary Signalized Intersection

Bit 3 -> FO – Secondary Signalized Intersection (Not in use)

Bit 4 ->

Bit 5 ->

Bit 6 ->

Bit 7 ->

Status

Bit 0 -> ON/OFF

Bit 1 -> GW – TCS in control, green wave

Bit 2 -> Blinking-yellow state

Bit 3 -> Illuminated Guidance Traffic Sign state

Bit 4 -> For future use

Bit 5 -> For future use

Bit 6 -> For future use

Bit 7 -> RESET

Request

Bit 0 -> Request to obtain the journal/event log

Bit 1 -> Request to obtain all parameters from the programs

Bit 2 -> For future use

Bit 3 -> For future use

Bit 4 -> Request to obtain GAP TIME definitions (extension unit)

Bit 5 -> For future use

Bit 6 -> 1 For future use

Bit 7 -> Request to obtain detectors traffic data.



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ID4:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 4 | |
| 11 | Program number | Traffic light Timing plan number 1-16 |
| 12 | Number of parameter group | Number of the block to send 1..5 |
| 13 | Number of parameters | Always 50 = as 50-byte block size |
| 14 | Parameter 1 | First byte of data |
| 15 | Parameter 2 | |
| 16 | Parameter 3 | |
| | ..... | Last byte of data (byte number 50) |
| | Reserved | For future use |
| | Reserved | For future use |
| | Check | |
| | 0x16 | |



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: ID5

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 5 | |
| 11 | Number of detector | Detector number |
| 12 | Number of time gaps | Always 16 = number of detectors plans |
| 13 | Time gap 1 | Extension unit's time gap for plan 1/17. |
| 14 | Time gap 2 | Extension unit's time gap for plan 2/18. |
| 15 | Time gap 3 | Extension unit's time gap for plan 3/19. |
| | ..... | Extension unit's time gap for plan 4/20. |
| | ..... | …Until plan16/32 |
| | Check | |
| | 0x16 | |

The extension unit is measured in tenths of a second:



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1 = tenths of a second

255 = 25.5 seconds

Byte 11: Number of detector

- To set the TLC real time clock, set

  Detector number to 255.

  Number of time gaps to 7

  Set:

  Time gap 1 : hour (bit 7 means that summer time is active)

  Time gap 2 : minute

  Time gap 3 : second

  Time gap 4 : day

  Time gap 5 : month

  Time gap 6 : year

  Time gap 7 : day of week

- Set the detector number to **254** to clear the journal.
- Set the detector number to **252** for clearing the memory of the counting data.

ID6:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |



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| | | |
|---|---|---|
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 6 | |
| 11 | Interval Duration in Seconds | Collecting period (Interval) |
| 12 | Reserve | |
| | Check | |
| | 0x16 | |

The traffic light controller performs, over a set interval time, counting of vehicles and calculation of occupancy on the detector. At the end of the interval, the data is stored in memory and the process starts again. The controller can store about 1200 records in memory (using the FIFO method).

The maximum period is 250 seconds and not less than 10 seconds in order not to overload the controller and it is also not practical to count in a shorter period than this.

ID10:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |



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| | | |
|---|---|---|
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 10 | |
| 11 | Number of program 0 – 17 | The active Traffic Light Timing Plan in the controller. |
| 12 | Status | Working state |
| 13 | actual second of cycle | Cycle's time in seconds |
| 14 | Occupation time detector 1 | Occupancy at detector 1 (in current second) |
| 15 | Occupation time detector 2 | Occupancy at detector 2 (in current second) |
| 16 | Occupation time detector 3 | Occupancy at detector 3 (in current second) |
| 17 | Occupation time detector 4 | Occupancy at detector 4 (in current second) |
| 18 | Occupation time detector 5 | Occupancy at detector 5 (in current second) |
| 19 | Occupation time detector 6 | Occupancy at detector 6 (in current second) |
| 20 | Occupation time detector 7 | Occupancy at detector 7 (in current second) |
| 21 | Occupation time detector 8 | Occupancy at detector 8 (in current second) |
| 22 | Occupation time detector 9 | Occupancy at detector 9 (in current second) |
| 23 | Occupation time detector 10 | Occupancy at detector 10 (in current second) |
| 24 | Occupation time detector 11 | Occupancy at detector 11 (in current second) |



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| | | |
|---|---|---|
| 25 | Occupation time detector 12 | Occupancy at detector 12 (in current second) |
| 26 | Occupation time detector 13 | Occupancy at detector 13 (in current second) |
| 27 | Occupation time detector 14 | Occupancy at detector 14 (in current second) |
| 28 | Occupation time detector 15 | Occupancy at detector 15 (in current second) |
| 29 | Occupation time detector 16 | Occupancy at detector 16 (in current second) |
| 30 | Occupation time detector 17 | Occupancy at detector 17 (in current second) |
| 31 | Occupation time detector 18 | Occupancy at detector 18 (in current second) |
| 32 | Occupation time detector 19 | Occupancy at detector 19 (in current second) |
| 33 | Occupation time detector 20 | Occupancy at detector 20 (in current second) |
| 34 | Occupation time detector 21 | Occupancy at detector 21 (in current second) |
| 35 | Occupation time detector 22 | Occupancy at detector 22 (in current second) |
| 36 | Signal status G1 + G2 | Light bulb state at movement 1+2 |
| 37 | Signal status G3 + G4 | Light bulb state at movement 3+4 |
| 38 | Signal status G5 + G6 | Light bulb state at movement 5+6 |
| 39 | Signal status G7 + G8 | Light bulb state at movement 7+8 |
| 40 | Signal status G9 + G10 | Light bulb state at movement 9+10 |
| 41 | Signal status G11 + G12 | Light bulb state at movement 11+12 |
| 42 | Signal status G13 + G14 | Light bulb state at movement 13+14 |



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| | | |
|---|---|---|
| 43 | Signal status G15 + G16 | Light bulb state at movement 15+16 |
| 44 | Signal status G17 + G18 | Light bulb state at movement 17+18 |
| 45 | Signal status G19 + G20 | Light bulb state at movement 19+20 |
| 46 | Signal status G21 + G22 | Light bulb state at movement 21+22 |
| 47 | Signal status G23 + G24 | Light bulb state at movement 23+24 |
| 48 | Signal status G25 + G26 | Light bulb state at movement 25+26 |
| 49 | Signal status G27 + G28 | Light bulb state at movement 27+28 |
| 50 | Signal status G29 + G30 | Light bulb state at movement 29+30 |
| 51 | Signal status G31 + G32 | Light bulb state at movement 31+32 |
| 52 | Signal status G33 + G34 | Light bulb state at movement 33+34 |
| 53 | Signal status G35 + G36 | Light bulb state at movement 35+36 |
| 54 | Signal status G37 + G38 | Light bulb state at movement 37+38 |
| 55 | Status detector 1 - 8 | Detectors 1-8 state (demand/no demand) at current second |
| 56 | Status detector 9 – 16 | Detectors 9-16 state (demand/no demand) at current second |
| 57 | Status detector 17 – 22 | Detectors 17-22 state (demand/no demand) at current second |
| 58 | special status | |
| 59 | Type TSC | Current phase number at current second |
| 60 | Check | |
| 61 | 0x16 | |



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Status

Bit 0 -> General fault

Bit 1 -> Light bulb failure (cross green or missing reds)

Bit 2 -> Manual operation (Police control)

Bit 3 -> Waiting for synchronization

Bit 4 -> TLC working or blinking in yellow

Bit 5 -> Green wave control

Bit 6 -> Lab mode / MAP ONLY

Bit 7 -> Traffic light Timing Plan 17-32

Occupation time

Occupancy time in the detector is measured in tenths of a second, so the maximum value is 10 (one second).

If the occupancy is maximum over a predetermined long period of time, the detector will indicate a fault.

Bit 0 - Bit 3 -> occupancy level/time

Bit 7 -> fault in detector

Signal status

Bit 0 - 3 Movement 1

Bit 4 – 7 Movement 2

Code:

| | |
|---|---|
| 0000 | off |
| 0001 | red |
| 0010 | yellow |
| 0100 | green |
| 1xxx | flashing |



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Detector status (22 detectors)

For each detector (22 in total) there is one (1) bit to represent a demand

Bit 0 -> Detector 1

Bit 1 -> Detector 2

Bit 2 -> Detector 3

Bit 3 -> Detector 4

Bit 4 -> Detector 5

Bit 5 -> Detector 6

Bit 6 -> Detector 7

Bit 7 -> Detector 8

ID11:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 11 | |
| 11 | Number of entry | Log entry number |



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| | | |
|---|---|---|
| 12 | Day | |
| 13 | Month | |
| 14 | Year | |
| 15 | Hour | |
| 16 | Minute | |
| 17 | Program number | Traffic Light Timing Plan |
| 18 | Second of cycle | |
| 19 | Type | Type of event or failure |
| 20 | Parameter 1 | The event parameters if exists |
| 21 | Parameter 2 | |
| 22 | Parameter 3 | |
| 23 | Parameter 4 | |
| 24 | Parameter 5 | |
| 25 | Parameter 6 | |
| 26 | Parameter 7 | |
| 27 | Parameter 8 | |
| 28 | Parameter 9 | |
| 29 | Parameter 10 | |
| 30 | Reserved | |
| 31 | Reserved | |
| 32 | Check | |
| 33 | 0x16 | |



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ID14:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 14 | |
| 11 | program number | Traffic Light Timing Plan |
| 12 | number of parameter set | Parameter block number |
| 13 | number of parameters | Number of parameters in block = always 50 |
| 14 | parameter start number | First parameter value |
| 15 | parameter start number + 1 | Second parameter value |
| 16 | parameter start number + 2 | Third parameter value |
| | parameter end number | Last parameter value |
| | Reserved | |
| | Reserved | |
| | Check | |
| | 0x16 | |



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ID15:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 15 | |
| 11 | detector number | |
| 12 | number of time gaps | Number of time pags value in message = always 16 |
| 13 | Time gap 1 | Extension unit value in plan 1 |
| | ..... | |
| | Time gap n | Extension unit value in plan 16 |
| | Check | |
| | 0x16 | |



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ID16:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TLC | |
| 7 | Address | |
| 8 | Address | |
| 9 | Address | |
| 10 | ID = 16 | |
| 11 | Interval Duration in Seconds | |
| 12 | Day | |
| 13 | Month | |
| 14 | Year | |
| 15 | Hour | |
| 16 | Minute | |
| 17 | Second | |
| 18 | Number of transmitted Detectors ( 1 – 10 ) | Number of detectors in message (in groups of maximum 10 in one message) For all detectors the TLC will send 3 messages. |
| 19 | Number of Detector | First Detector ID in message |



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| | | |
|---|---|---|
| 20 | Count Value ( 0 – 255 ) | Volume at first detector |
| 21 | Occupation Value ( 0 – 100 ) | Occupancy at first detector |
| 22 | Number of Detector | Next detector ID in message |
| | ... | Volume at the detector… |
| | ... | Occupancy at detector… |
| | Status | |
| | Check | |
| | 0x16 | |

In case of detector has fault in counting, the value of Count value is 255.

In case occupation value = 101 --> the detector had a malfunction during the measuring interval

In case occupation value = 102 --> Overrun during the measuring interval



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## Appendix 5 – DVI protocol type B

# Transmission interface for light signal installations

# Ver03

- This document is intended to give information about the meaning of the bytes in each identifier structure and not beyond.
- It is possible that mistakes occurs in this document. In this case please refer to SWARCO "DVI35" for Actros Ver1.4.

The structure of the protocol is based on the standard IEC 870-5-2.

**Note:** The additional features of ver02 are signed in red

### Identifier

**From host computer to traffic signal controller (TSC).**

ID1 – Commands to TSC.

ID4 – Change the program parameters.

ID5 – Set TSC Real Time Clock && clrear Journal , Counting Data.

**From TSC to host computer.**

ID10 – Feedback from the TSC. } Only one of these IDs is active, ID110 – Feedback from the TSC. } depending on initialization in ID120 – Feedback from the TSC. the traffic signal controller.

ID11 – Journal. See further explanation for the ID14 – Program Parameters. method of initializing below ID16 – Program Counters.



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Commands to the TSC (Traffic Controller):

| | | |
|---|---|---|
| 1 | 0x68 | Start of Command |
| 2 | Number of data bytes | Number of data bytes from Command field till status3 field (The byte before Check field). |
| 3 | Number of data bytes | Number of data bytes from Command field till status3 field (The byte before Check field). |
| 4 | 0x68 | Start of Command |
| 5 | Command | See attached document |
| 6 | Address from TSC | Address of TSC - Always 01 |
| 7 | Address | Always 00 |
| 8 | Address | Always 00 |
| 9 | Address | Always 00 |
| 10 | ID = 1 | Identifier |
| 11 | Program | Program Number |
| 12 | Impulse | Data according the identifier |
| 13 | Status | Data according the identifier |
| 14 | Request | Data according the identifier |
| 15 | Status2 | Data according the identifier |
| 16 | Status3 | Data according the identifier |
| 17 | Check | Check sum of all bytes from Command field till status3. |
| 18 | 0x16 | End Byte |

**Note:**

For all commands Byte7, Byte8 and Byte9 are 0.

For all commands Byte6 (address of TSC) is 1.

Byte5 – Command is T.B.D

1. See document IEC870-5-2 paragraph 4.2.3, 4.2.4 for information about the Command field (Byte 5). In this document the following Constants are used for the Command field.

&H9 Request status of link (hand check - short telegram)

&H0 Reset remote link (hand check - short telegram)

&H43 long telegram

&H4b short telegram



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2. Initialization of the DVI35 protocol and start communication:

**Protocol Initialization:**

Xmit: ->> 10 09 01 0A 16

Rcx : <<- 10 0B 01 0C 16

**Protocol Initialization:**

Xmit: ->> 10 00 01 01 16

Rcx : <<- 10 0B 01 0C 16 E5

**Sending ID1**

Xmit: ->> 68 0C 0C 68 43 01 00 00 00 01 01 00 01 00 00 00 47 16 Rcx : <<- E5

**Sending short telegram**

Xmit: ->> 10 4B 01 4C 16

**Receive ID10**

Rcx : <<- 68 37 37 68 08 01 00 00 01 0A 01 50 2B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 11 41 14 41 44 11 1E 4B 00 00 00 00 00 00 00 00 00 00 00 00 60 00 00 00 00 69 16

**Sending short telegram**

Xmit: ->> 10 4B 01 4C 16

**Receive E5 (No new data)**

Rcx : <<- E5



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ID1:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 1 | |
| 11 | Program Number | |
| 12 | Impulse | |
| 13 | Status | |
| 14 | Request | |
| 15 | Set detector 1 - 8 | |
| 16 | Set detector 9 - 16 | |
| 17 | Set detector 17 - 22 | |
| 18 | Future used byte 1 | |
| 19 | Future used byte 2 | |
| 20 | Future used byte 3 | |
| 21 | Future used byte 4 | |
| 22 | Future used byte 5 | |
| 23 | Hand program - ADV | |
| 24 | Program Number in case of parameters Upload | |
| 25 | Block number in case of parameters Upload | Select 1 of five blocks for each program. Block is 50 parameters |
| 26 | Check | |
| 27 | 0x16 | |

Byte 11 – Program Number is relevant in SYCC and PRCC Controller operation mode only. It is used to set the Traffic Controller program number. The desired Program Number is set for all nodes of the Controller



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Byte 12 – Impulse is relevant in SYCC Controller operation mode only. SY is the synchronization pulse from Control Center. We use Bit 0 to synchronize all nodes of the Controller.

In DVI35 "ini" file it is possible to select which SY pulse will be used for each intersection.

Bit 0 -> SY_Node1
Bit 1 -> SY_Node2
Bit 2 -> SY_Node3
Bit 3 -> Not Used
Bit 4 -> Not Used
Bit 5 -> Not Used
Bit 6 -> Not Used
Bit 7 -> Not Used

Byte 13 - Status

Bit 0 -> Controller ON/OFF
"0" = OFF (Blink), "1" = ON.
Bit 1 -> Not Used
Bit 2 -> Blink_Node1
Bit 3 -> Blink_Node2
Bit 4 -> Mode_Bit4
Bit 5 -> Mode_Bit5
Bit 6 -> Control of Signs:
'1' - Signs ON
'0' - Signs controlled by controller application.
Bit 7 -> Not Used

| Blink Mode | Blink_Node1 | Blink_Node2 | Notes |
|---|---|---|---|
| Normal – No Blink | 1 | 1 | |
| Blink Node 1 | 0 | 1 | |
| Blink Node 2 | 1 | 0 | |
| Blink Two Nodes | 0 | 0 | |



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**Notes:**

1. Bits 0, 2, 3 will take effect in SYCC or PRCC Controller operation modes.
2. The flag "switchnodeseperate" in the Actros intersection application is set to True.

## Controller Operation Modes

| Mode Of Operation | Mode_Bit4 | Mode_Bit5 | Notes |
|---|---|---|---|
| CLK | 0 | 0 | Clock Mode |
| PRCC | 1 | 0 | Program Number is relevant |
| SYCC | 0 | 1 | Program Number and SY pulse are relevant |
| Not Used | 1 | 1 | |

Byte 14 - Request

Bit 0 -> Upload Journal
Bit 1 -> Upload Parameters
Bit 2 -> Not Used
Bit 3 -> Not Used
Bit 4 -> Not Used
Bit 5 -> Not Used
Bit 6 -> Not Used
Bit 7 -> Upload Detector Counting

The Control computer will set one of the ID1/Request bits to get response from the Traffic Controller.

The response of the Traffic Controller to ID1/Request/Bit 0 ➔ Journal, ID11.

A journal entry can be sent every cycle. 10 parameters are transmitted per announcement. If the parameters are not used, 00 are registered.



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The response of the Traffic Controller to ID1/Request/Bit 1 ➔ Upload Parameters. ID14.

The Traffic Controller will send the Control Computer 250 parameters of the specific program selected by Byte 24. The 250 parameters of this program will be sent in five blocks each of 50 parameters.

The response of the Traffic Controller to ID1/Request/Bit 7 ➔ Upload Detector Counting, ID16.

Bytes 15, 16, 17: Each Bit enables to force Detector presence.

'1' – Force Detector channel.

'0' – Normal

It is possible to force Detector channel from the following sources:

- Bytes 15, 16, 17 of Identifier 1.
- DVI35 parameters according to the specific program.
- BDI.
- Presence of vehicle on loop.

Bytes 18 – 22: 5 Bytes for future used. Setting one of the Bits in these 5 Bytes will set the appropriate 5 Bytes in Traffic Controller application.

Byte 23 - Hand program.

Bit 0 – Hand Mode/Auto.

Bit 1 – ADVANCE

Bit 2 – Not Used

Bit 3 – Not Used

Bit 4 – Not Used

Bit 5 – Not Used

Bit 6 – Not Used

Bit 7 – Not Used

If this feature is enabled, It is possible that the operator will forget to move to Auto mode and the intersection will stay in Hand mode.



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Byte 24 – Number of Program in case of parameters upload done by ID14 in response to ID1/Request/Bit 1.

Byte 25 – Block number of the program selected in Byte 24, in case of parameters Upload

ID4:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 4 | |
| 11 | Number of program | |
| 12 | Number of parameter group | Number of block to download (1 - 5). |
| 13 | Number of parameters | Always 50 parameters to download |
| 14 | Parameter 1 | First parameter to download |
| 15 | Parameter 2 | Second parameter to download |
| 16 | Parameter 3 | Third parameter to download |
| | ..... | |
| | ..... | Parameter 50 – end of data block |
| | Reserved | Not Used |
| | Reserved | Not Used |
| | Check | |
| | 0x16 | |



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ID4 – Download program parameters to the Traffic Controller. The quantity of parameters in one download cycle is limited to 50.

To download a block of 50 parameters it is needed to set ID4/Byte 11 "Program Number", ID4/Byte 12 "Number of parameter block" and ID14/Byte13 "Number of parameters" which should be set to 50.

ID5:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 5 | |
| 11 | Number of detector | |
| 12 | Number of time gaps | |
| 13 | Hour | |
| 14 | Minutes | |
| 15 | Seconds | |
| 16 | day | |
| 17 | month | |
| 17 | year | |
| 18 | Day Of Week | |
| 19 | Check | |
| 20 | 0x16 | |

ID5 – Sent from Control Computer to set the Traffic Controller Real Time Clock (RTC) and to clear Journal and Counting Data.

Byte 11: Number of detector.

Value of 255 – Set the Traffic Controller real time clock. In this case Byte 12 (Number of time gaps) should be 7.

Value of 254 – Clear Journal.



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Value of 252 – Clear memory of Counting Data.

Either one of ID10, ID110 or ID120 could be defined as a response to ID1.
The way of defining which ID would be use is in dvi35.ini:

```
[dvi35-protocol]
dvi35Address        = 1
sendTimer           = 1
rxTimeoutTimer      = 100
lineBreakTimer      = 3000
rueckmeldeID        = 110
ignoreFCV       = 0
```

Insert here which ID is to be in response to ID10, ID110 or

ID10:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 10 | |
| 11 | Number of program | |
| 12 | Status | |
| 13 | actual second of cycle | |
| 14 | Not Used | |
| 15 | Not Used | |
| 16 | Not Used | |
| 17 | Not Used | |
| 18 | Not Used | |
| 19 | Not Used | |
| 20 | Not Used | |
| 21 | Not Used | |
| 22 | Not Used | |
| 23 | Not Used | |
| 24 | Not Used | |



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| | | |
|---|---|---|
| 25 | Not Used | |
| 26 | Not Used | |
| 27 | Not Used | |
| 28 | Not Used | |
| 29 | Not Used | |
| 30 | Not Used | |
| 31 | Not Used | |
| 32 | Not Used | |
| 33 | Not Used | |
| 34 | Not Used | |
| 35 | Not Used | |
| 36 | Signal status G1 + G2 | Signal Status phases 1, 2 |
| 37 | Signal status G3 + G4 | |
| 38 | Signal status G5 + G6 | |
| 39 | Signal status G7 + G8 | |
| 40 | Signal status G9 + G10 | |
| 41 | Signal status G11 + G12 | |
| 42 | Signal status G13 + G14 | |
| 43 | Signal status G15 + G16 | |
| 44 | Signal status G17 + G18 | |
| 45 | Signal status G19 + G20 | |
| 46 | Signal status G21 + G22 | |
| 47 | Signal status G23 + G24 | |
| 48 | Signal status G25 + G26 | |
| 49 | Signal status G27 + G28 | |
| 50 | Signal status G29 + G30 | |
| 51 | Signal status G31 + G32 | |
| 52 | Signal status G33 + G34 | |
| 53 | Signal status G35 + G36 | |
| 54 | Signal status G37 + G38 | Signal Status phases 37, 38 |
| 55 | Status detector 1 - 8 | |
| 56 | Status detector 9 – 16 | |
| 57 | Status detector 17 – 22 | |
| 58 | special status – Not Used | |
| 59 | Type TSC - Not Used | |
| 60 | Check | |
| 61 | 0x16 | |



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ID110:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 10 | |
| 11 | Number of program Node 1 | |
| 12 | Number of program Node 2 | |
| 13 | Status Node 1 | |
| 14 | Status Node 2 | |
| 15 | actual second of cycle Node 1 | |
| 16 | actual second of cycle Node 2 | |
| 17 | RTC – hour | |
| 18 | RTC – minute | |
| 19 | RTC – second | |
| 20 | RTC – day | |
| 21 | RTC – month | |
| 22 | RTC – year | |
| 23 | RTC – day of week | |
| 24 | Preemption 1 | |
| 25 | Preemption 2 | |
| 26 | Preemption 3 | |
| 27 | Preemption 4 | |
| 28 | Preemption 5 | |
| 29 | Preemption 6 | |
| 30 | Preemption 7 | |
| 31 | Preemption 8 | |
| 32 | Preemption 9 | |
| 33 | Preemption 10 | |



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| | | |
|---|---|---|
| 34 | Future used byte 1 | |
| 35 | Future used byte 2 | |
| 36 | Future used byte 3 | |
| 37 | Future used byte 4 | |
| 38 | Future used byte 5 | |
| 39 | Signal status G1 + G2 | Signal Status phases 1, 2 |
| 40 | Signal status G3 + G4 | |
| 41 | Signal status G5 + G6 | |
| 42 | Signal status G7 + G8 | |
| 43 | Signal status G9 + G10 | |
| 44 | Signal status G11 + G12 | |
| 45 | Signal status G13 + G14 | |
| 46 | Signal status G15 + G16 | |
| 47 | Signal status G17 + G18 | |
| 48 | Signal status G19 + G20 | |
| 49 | Signal status G21 + G22 | |
| 50 | Signal status G23 + G24 | |
| 51 | Signal status G25 + G26 | |
| 52 | Signal status G27 + G28 | |
| 53 | Signal status G29 + G30 | |
| 54 | Signal status G31 + G32 | |
| 55 | Signal status G33 + G34 | |
| 56 | Signal status G35 + G36 | |
| 57 | Signal status G37 + G38 | Signal Status phases 37, 38 |
| 58 | Status detector 1 - 8 | |
| 59 | Status detector 9 – 16 | |
| 60 | Status detector 17 – 22 | |
| 61 | Phase number Node 1 | |
| 62 | Phase number Node 2 | |
| 63 | Phase second Node 1 | |
| 64 | Phase second Node 2 | |
| 65 | Detector fault 1 - 8 | |
| 66 | Detector fault 9 – 16 | |
| 67 | Detector fault 17 – 22 | |
| 68 | Check | |
| 69 | 0x16 | |



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## ID120:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 10 | |
| 11 | Number of program Node 1 | |
| 12 | Number of program Node 2 | |
| 13 | Status Node 1 | |
| 14 | Status Node 2 | |
| 15 | actual second of cycle Node 1 | |
| 16 | actual second of cycle Node 2 | |
| 17 | RTC – hour | |
| 18 | RTC – minute | |
| 19 | RTC – second | |
| 20 | RTC – day | |
| 21 | RTC – month | |
| 22 | RTC – year | |
| 23 | RTC – day of week | |
| 24 | Preemption 1 | |
| 25 | Preemption 2 | |
| 26 | Preemption 3 | |
| 27 | Preemption 4 | |
| 28 | Preemption 5 | |
| 29 | Preemption 6 | |
| 30 | Preemption 7 | |
| 31 | Preemption 8 | |
| 32 | Preemption 9 | |



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| | | |
|---|---|---|
| 33 | Preemption 10 | |
| 34 | Future used byte 1 | |
| 35 | Future used byte 2 | |
| 36 | Future used byte 3 | |
| | Future used byte 4 | |
| 38 | Future used byte 5 | |
| 39 | Signal status G1 + G2 | Signal Status phases 1, 2 |
| 40 | Signal status G3 + G4 | |
| 41 | Signal status G5 + G6 | |
| 42 | Signal status G7 + G8 | |
| 43 | Signal status G9 + G10 | |
| 44 | Signal status G11 + G12 | |
| 45 | Signal status G13 + G14 | |
| 46 | Signal status G15 + G16 | |
| 47 | Signal status G17 + G18 | |
| 48 | Signal status G19 + G20 | |
| 49 | Signal status G21 + G22 | |
| 50 | Signal status G23 + G24 | |
| 51 | Signal status G25 + G26 | |
| 52 | Signal status G27 + G28 | |
| 53 | Signal status G29 + G30 | |
| 54 | Signal status G31 + G32 | |
| 55 | Signal status G33 + G34 | |
| 56 | Signal status G35 + G36 | |
| 57 | Signal status G37 + G38 | Signal Status phases 37, 38 |
| 58 | Status detector 1 - 8 | |
| 59 | Status detector 9 – 16 | |
| 60 | Status detector 17 – 22 | |
| 61 | Phase number Node 1 | |
| 62 | Phase number Node 2 | |
| 63 | Phase second Node 1 | |
| 64 | Phase second Node 2 | |
| 65 | Detector fault 1 - 8 | |
| 66 | Detector fault 9 – 16 | |
| 67 | Detector fault 17 – 22 | |
| 68 | Occupation time detector 1 | |
| … | | |



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| | | |
|---|---|---|
| 89 | Occupation time detector 22 | |
| 90 | Reserve 1 | |
| … | | |
| 121 | Reserve 32 | |
| 122 | Check | |
| 123 | 0x16 | |

D10/ID110/ID120 – Is sent from Traffic Controller to Control Computer in response to ID1 or in response to short telegram. In case of no change in ID10 the Traffic Controller should send E5 which means no new information.

Byte 13 – Status Node 1

Bit 0 -> Failure
Bit 1 -> Lamp failure (burnt traffic red lamp or crossing green lamps)
Bit 2 -> Hand mode
Bit 3 -> Coordination position (waiting for SY)
Bit 4 -> Traffic Controller On/Off
Bit 5 -> Green Wave On/Off
Bit 6 -> Mode of Operation
Bit 7 -> Mode of Operation

Byte 14 – Status Node 2

Bit 0 -> Police door is open (The status is read from one of the IO64 inputs)
Bit 1 -> Lamp failure (burnt traffic red lamp or crossing green lamps)
Bit 2 -> Hand mode
Bit 3 -> Coordination position (waiting for SY)
Bit 4 -> Traffic Controller On/Off
Bit 5 -> Green Wave On/Off



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Bit 6 -> Mode of Operation

Bit 7 -> Mode of Operation

| Mode Of Operation | Mode_Bit6 | Mode_Bit7 | Notes |
|---|---|---|---|
| CLK | 0 | 0 | Clock Mode |
| PRCC | 1 | 0 | |
| SYCC | 0 | 1 | |
| Not Used | 1 | 1 | |

Bytes 24 - 33, These 10 Bytes of Preemption will be sent from the traffic application to the Control Center. Each byte will be used for one preemption detector which includes 6 Inputs that will be connected to the I/O24 of the Actros.

Bytes 34 - 38, These 5 Bytes will be send from the Traffic application to Control Center.

For future use.

Byte 39 – Byte 57 Signal Status

Bit 0 - 3 Phase 1

Bit 4 - 7 Phase 2

Code:

| | |
|---|---|
| 0000 | off |
| 0001 | red |
| 0010 | yellow |
| 0100 | green |
| 1xxx | flashing |

Byte 58 – Byte 60 Detector status (22 detectors)

One Bit for presence for each of the 22 Detectors.

Bit 0 -> Detector 1 presence



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| | | |
|---|---|---|
| Bit 1 | -> | Detector 2 presence |
| Bit 2 | -> | Detector 3 presence |
| Bit 3 | -> | Detector 4 presence |
| Bit 4 | -> | Detector 5 presence |
| Bit 5 | -> | Detector 6 presence |
| Bit 6 | -> | Detector 7 presence |
| Bit 7 | -> | Detector 8 presence |

Byte 65 – Byte 67, Three Bytes for Detector fault. Each Bit for one Detector fault. In Traffic application three Bytes will be updated for Detector fault. Detector will be in fault position in case it is free for time longer than 24 hours or busy more than 15 minutes.

ID11:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 11 | |
| 11 | Number of entry | |
| 12 | Day | |
| 13 | Month | |
| 14 | Year | |
| 15 | Hour | |
| 16 | Minute | |
| 17 | Program number | |
| 18 | Second of cycle | |
| 19 | Type | Type of announcement |
| 20 | Parameter 1 | |



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| | | |
|---|---|---|
| 21 | Parameter 2 | |
| 22 | Parameter 3 | |
| 23 | Parameter 4 | |
| 24 | Parameter 5 | |
| 25 | Parameter 6 | |
| 26 | Parameter 7 | |
| 27 | Parameter 8 | |
| 28 | Parameter 9 | |
| 29 | Parameter 10 | |
| 30 | Reserved | |
| 31 | Reserved | |
| 32 | Check | |
| 33 | 0x16 | |

The journal announcement is the response to ID1/Request/Bit 0. A journal entry can be sent every cycle. 10 parameters are transmitted per announcement. If the parameters are not used, 00 are registered. Each entry consists of time stamp (Byte12 – Byte16), program number (Byte17), cycle second (Byte18), type of announcement (Byte19) and 10 announcement parameters (Byte20 – Byte29).

ID14:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 14 | |
| 11 | program number | |
| 12 | number of parameter set | Number of block to (1 - 5). |
| 13 | number of parameters | Always 50 parameters to download |
| 14 | parameter start number | First parameter |
| 15 | parameter start number + 1 | Second parameter |
| 16 | parameter start number + 2 | |



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| | | |
|---|---|---|
| | .... | |
| | parameter end number | Parameter 50 |
| | Reserved | |
| | Reserved | |
| | Check | |
| | 0x16 | |

ID14 is sent in response to ID1/Request/Bit 1.

The Traffic Controller sends the Control Computer 50 parameters for the desired program and desired block selected by ID1/Byte 24, ID1/Byte 25.

Byte11 contain the program number.

Byte 12 contain the number of block which is a number between 1 – 5. Byte13 contain the quantity of parameters in block which should be 50.

ID16:

| | | |
|---|---|---|
| 1 | 0x68 | |
| 2 | Number of data bytes | |
| 3 | Number of data bytes | |
| 4 | 0x68 | |
| 5 | Command | |
| 6 | Address from TSC | 1 |
| 7 | Address | 0 |
| 8 | Address | 0 |
| 9 | Address | 0 |
| 10 | ID = 16 | |
| 11 | Interval Duration in Seconds | NOT USED – Interval Time is always one Application Cycle. |
| 12 | Number of transmitted Detectors | Always 22 |
| 13 | Number of Detector | |
| 14 | Count Value ( 0 – 255 ) | Counting |
| 15 | Occupation Value ( 0 – 100 ) | Occupancy in percentage |
| 16 | Number of Detector | Number of next Detector |
| 17 | Count Value ( 0 – 255 ) | Counting |
| 18 | Occupation Value ( 0 – 100 ) | Occupancy in percentage |
| | …… | Number of next Detector |
| | …… | Counting |



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| | | |
|---|---|---|
| | …… | Occupancy in percentage |
| | Status | |
| | Check | |
| | 0x16 | |

ID16 :

The interval time for counting is always one Application Cycle.

Upload Detector Counting is sent in response to ID1/Request/Bit 7.

ID16 detector counting is sent three times in response to ID1/Request/Bit 7.

First detector counting will contain counters of Detectors 1-10.

Second detector counting will contain counters of Detectors 11 - 20.

Third detector counting will contain counters of Detectors 21, 22. The Traffic Controller will include only the last counting of last application cycle.

Since reading the counting from host computer, till new counting accumulated in TSC, the response to ID1/Request/Bit 7 will be E5 (no new counting available).



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# Appendix 6 – Modbus protocol

1. The listed addresses are for recommendation purposes only; the traffic light controller supplier may define a range of other addresses for each type of traffic light controller offered by them, as long as the addresses are standard.
2. For Double Signalized Intersection, writing the program for the work is one for both junctions.
3. The reading by the traffic management and control system will be carried out for each intersection separately.

Table 10 - Reading - Status Data

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 1 | 30011 | | Real time clock - Month | Real time clock - Year | |
| 2 | 30012 | | Real time clock - Hour | Real time clock - day of month | |
| 3 | 30013 | | Real time clock - second | Real time clock - minute | |
| 4 | 30014 | | Reserved | Reserved | |
| 5 | 30015 | | Reserved | Reserved | |
| 6 | 30016 | | Reserved | Reserved | |
| 7 | 30017 | | Reserved | Reserved | |
| 8 | 30018 | | Reserved | Reserved | |
| 9 | 30019 | | Reserved | Reserved | |
| 10 | 30020 | | Reserved | Reserved | |
| 11 | 30021 | | Program Number - Actual | Current Time in cycle | Main Signalized Intersection |
| 12 | 30022 | | Phase number | Time in phase | Main Signalized Intersection |
| 13 | 30023 | | status – working state | | Main Signalized Intersection |
| 14 | 30024 | | Program Number - Actual | Current Time in cycle | Secondary Signalized Intersection |
| 15 | 30025 | | Phase number | Time in phase | Secondary Signalized Intersection |
| 16 | 30026 | | status – working state | | Secondary Signalized Intersection |
| 17 | 30027 | | Status – police mode | Controller fault | |
| 18 | 30028 | | Fault in the light bulbs | Cross green fault | |
| 19 | 30029 | | Reserved | Reserved | |
| 20 | 30030 | | Reserved | Reserved | |
| 21 | 30031 | | Reserved | Reserved | |
| 22 | 30032 | | Free entries 1-16 | | |
| 23 | 30033 | | Priority detector 1 state | Priority detector 2 state | |
| 24 | 30034 | | Priority detector 3 state | Priority detector 4 state | |
| 25 | 30035 | | Priority detector 5 state | Priority detector 6 state | |



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| | | | | | |
|---|---|---|---|---|---|
| 26 | 30036 | | Priority detector 7 state | Priority detector 8 state | |
| 27 | 30037 | | Priority detector 9 state | Priority detector 10 state | |
| 28 | 30038 | | Priority detector 11 state | Priority detector 12 state | |
| 29 | 30039 | | Reserved | Reserved | |
| 30 | 30040 | | Reserved | Reserved | |
| 31 | 30041 | | Light bulb 1-2 state | Light bulb 3-4 state | Light bulb in format BCD |
| 32 | 30042 | | Light bulb 5-6 state | Light bulb 7-8 state | |
| 33 | 30043 | | Light bulb 9-10 state | Light bulb 11-12 state | |
| 34 | 30044 | | Light bulb 13-14 state | Light bulb 15-16 state | |
| 35 | 30045 | | Light bulb 17-18 state | Light bulb 19-20 state | |
| 36 | 30046 | | Light bulb 21-22 state | Light bulb 23-24 state | |
| 37 | 30047 | | Light bulb 25-26 state | Light bulb 27-28 state | |
| 38 | 30048 | | Light bulb 29-30 state | Light bulb 31-32 state | |
| 39 | 30049 | | Light bulb 33-34 state | Light bulb 35-36 state | |
| 40 | 30050 | | Light bulb 37-38 state | Light bulb 39-40 state | |
| 41 | 30051 | | Light bulb 41-42 state | Light bulb 43-44 state | |
| 42 | 30052 | | Light bulb 45-46 state | Light bulb 47-48 state | |
| 43 | 30053 | | Detectors state 1-16 | | |
| 44 | 30054 | | Detectors state 17-30 | | |
| 45 | 30055 | | Detector fault 1-16 | | |
| 46 | 30056 | | Detector fault 17-30 | | |
| 47 | 30057 | | | | |
| 48 | 30058 | | | | |
| 49 | 30059 | | | | |
| 50 | 30060 | | | | |

*Table 11 - Reading - Detector Data (Detector 1-16)*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 51 | 30101 | | Detector number 1 | Count | |
| 52 | 30102 | | Occupancy | | |
| 53 | 30103 | | Volume | | |
| 54 | 30104 | | Detector number 2 | Count | |
| 55 | 30105 | | Occupancy | | |
| 56 | 30106 | | Volume | | |
| 57 | 30107 | | Detector number 3 | Count | |
| 58 | 30108 | | Occupancy | | |
| 59 | 30109 | | Volume | | |
| 60 | 30110 | | Detector number 4 | Count | |
| 61 | 30111 | | Occupancy | | |
| 62 | 30112 | | Volume | | |
| 63 | 30113 | | Detector number 5 | Count | |



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| | | | | | |
|---|---|---|---|---|---|
| 64 | 30114 | | Occupancy | | |
| 65 | 30115 | | Volume | | |
| 66 | 30116 | | Detector number 6 | Count | |
| 67 | 30117 | | Occupancy | | |
| 68 | 30118 | | Volume | | |
| 69 | 30119 | | Detector number 7 | Count | |
| 70 | 30120 | | Occupancy | | |
| 71 | 30121 | | Volume | | |
| 72 | 30122 | | Detector number 8 | Count | |
| 73 | 30123 | | Occupancy | | |
| 74 | 30124 | | Volume | | |
| 75 | 30125 | | Detector number 9 | Count | |
| 76 | 30126 | | Occupancy | | |
| 77 | 30127 | | Volume | | |
| 78 | 30128 | | Detector number 10 | Count | |
| 79 | 30129 | | Occupancy | | |
| 80 | 30130 | | Volume | | |
| 81 | 30131 | | Detector number 11 | Count | |
| 82 | 30132 | | Occupancy | | |
| 83 | 30133 | | Volume | | |
| 84 | 30134 | | Detector number 12 | Count | |
| 85 | 30135 | | Occupancy | | |
| 86 | 30136 | | Volume | | |
| 87 | 30137 | | Detector number 13 | Count | |
| 88 | 30138 | | Occupancy | | |
| 89 | 30139 | | Volume | | |
| 90 | 30140 | | Detector number 14 | Count | |
| 91 | 30141 | | Occupancy | | |
| 92 | 30142 | | Volume | | |
| 93 | 30143 | | Detector numner 15 | Count | |
| 94 | 30144 | | Occupancy | | |
| 95 | 30145 | | Volume | | |
| 96 | 30146 | | Detector numner 16 | Count | |
| 97 | 30147 | | Occupancy | | |
| 98 | 30148 | | Volume | | |

*Table 12 - Reading - Detector Data (Detector 17-22)*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 99 | 30149 | | Detector numner 17 | Count | |
| 100 | 30150 | | Occupancy | | |
| 101 | 30151 | | Volume | | |
| 102 | 30152 | | Detector numner 18 | Count | |
| 103 | 30153 | | Occupancy | | |
| 104 | 30154 | | Volume | | |
| 105 | 30155 | | Detector numner 19 | Count | |
| 106 | 30156 | | Occupancy | | |
| 107 | 30157 | | Volume | | |
| 108 | 30158 | | Detector numner 20 | Count | |
| 109 | 30159 | | Occupancy | | |
| 110 | 30160 | | Volume | | |



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| | | | | | |
|---|---|---|---|---|---|
| 111 | 30161 | | Detector numner 21 | Count | |
| 112 | 30162 | | Occupancy | | |
| 113 | 30163 | | Volume | | |
| 114 | 30164 | | Detector numner 22 | Count | |
| 115 | 30165 | | Occupancy | | |
| 116 | 30166 | | Volume | | |



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*Table 13 – Reading - journal/log*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 1 | 20001 | | Month | Year | Record 1 |
| 2 | 20002 | | Hour | Day of the month | |
| 3 | 20003 | | Second | Minute | |
| 4 | 20004 | | Fault code | ---- | |
| 5 | 20005 | | Parameter 2 | Parameter 1 | |
| 6 | 20006 | | Month | Year | Record 2 |
| 7 | 20007 | | Hour | Day of the month | |
| 8 | 20008 | | Second | Minute | |
| 9 | 20009 | | Fault code | ---- | |
| 10 | 20010 | | Parameter 2 | Parameter 1 | |
| 11 | 20011 | | Month | Year | Record 3 |
| 12 | 20012 | | Hour | Day of the month | |
| 13 | 20013 | | Second | Minute | |
| 14 | 20014 | | Fault code | ---- | |
| 15 | 20015 | | Parameter 2 | Parameter 1 | |
| 16 | 20016 | | Month | Year | Record 4 |
| 17 | 20017 | | Hour | Day of the month | |
| 18 | 20018 | | Second | Minute | |
| 19 | 20019 | | Fault code | ---- | |
| 20 | 20020 | | Parameter 2 | Parameter 1 | |
| 21 | 20021 | | Month | Year | Record 5 |
| 22 | 20022 | | Hour | Day of the month | |
| 23 | 20023 | | Second | Minute | |
| 24 | 20024 | | Fault code | ---- | |
| 25 | 20025 | | Parameter 2 | Parameter 1 | |
| 26 | 20026 | | Month | Year | Record 6 |
| 27 | 20027 | | Hour | Day of the month | |
| 28 | 20028 | | Second | Minute | |
| 29 | 20029 | | Fault code | ---- | |
| 30 | 20030 | | Parameter 2 | Parameter 1 | |
| 31 | 20031 | | Month | Year | Record 7 |
| 32 | 20032 | | Hour | Day of the month | |
| 33 | 20033 | | Second | Minute | |
| 34 | 20034 | | Fault code | ---- | |
| 35 | 20035 | | Parameter 2 | Parameter 1 | |
| 36 | 20036 | | Month | Year | Record 8 |
| 37 | 20037 | | Hour | Day of the month | |
| 38 | 20038 | | Second | Minute | |
| 39 | 20039 | | Fault code | ---- | |
| 40 | 20040 | | Parameter 2 | Parameter 1 | |
| 41 | 20041 | | Month | Year | Record 9 |
| 42 | 20042 | | Hour | Day of the month | |
| 43 | 20043 | | Second | Minute | |
| 44 | 20044 | | Fault code | ---- | |
| 45 | 20045 | | Parameter 2 | Parameter 1 | |
| 46 | 20046 | | Month | Year | Record 10 |
| 47 | 20047 | | Hour | Day of the month | |
| 48 | 20048 | | Second | Minute | |
| 49 | 20049 | | Fault code | ---- | |
| 50 | 20050 | | Parameter 2 | Parameter 1 | |



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*Table 14 - Reading - Plan information (Parameters 1-100)*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 1 | 30501 | | Plan No XX - Param 1 | Plan No XX - Param 2 | |
| 2 | 30502 | | Plan No XX - Param 3 | Plan No XX - Param 4 | |
| 3 | 30503 | | Plan No XX - Param 5 | Plan No XX - Param 6 | |
| 4 | 30504 | | Plan No XX - Param 7 | Plan No XX - Param 8 | |
| 5 | 30505 | | Plan No XX - Param 9 | Plan No XX - Param 10 | |
| 6 | 30506 | | Plan No XX - Param 11 | Plan No XX - Param 12 | |
| 7 | 30507 | | Plan No XX - Param 13 | Plan No XX - Param 14 | |
| 8 | 30508 | | Plan No XX - Param 15 | Plan No XX - Param 16 | |
| 9 | 30509 | | Plan No XX - Param 17 | Plan No XX - Param 18 | |
| 10 | 30510 | | Plan No XX - Param 19 | Plan No XX - Param 20 | |
| 11 | 30511 | | Plan No XX - Param 21 | Plan No XX - Param 22 | |
| 12 | 30512 | | Plan No XX - Param 23 | Plan No XX - Param 24 | |
| 13 | 30513 | | Plan No XX - Param 25 | Plan No XX - Param 26 | |
| 14 | 30514 | | Plan No XX - Param 27 | Plan No XX - Param 28 | |
| 15 | 30515 | | Plan No XX - Param 29 | Plan No XX - Param 30 | |
| 16 | 30516 | | Plan No XX - Param 31 | Plan No XX - Param 32 | |
| 17 | 30517 | | Plan No XX - Param 33 | Plan No XX - Param 34 | |
| 18 | 30518 | | Plan No XX - Param 35 | Plan No XX - Param 36 | |
| 19 | 30519 | | Plan No XX - Param 37 | Plan No XX - Param 38 | |
| 20 | 30520 | | Plan No XX - Param 39 | Plan No XX - Param 40 | |
| 21 | 30521 | | Plan No XX - Param 41 | Plan No XX - Param 42 | |
| 22 | 30522 | | Plan No XX - Param 43 | Plan No XX - Param 44 | |
| 23 | 30523 | | Plan No XX - Param 45 | Plan No XX - Param 46 | |
| 24 | 30524 | | Plan No XX - Param 47 | Plan No XX - Param 48 | |
| 25 | 30525 | | Plan No XX - Param 49 | Plan No XX - Param 50 | |
| 26 | 30526 | | Plan No XX - Param 51 | Plan No XX - Param 52 | |
| 27 | 30527 | | Plan No XX - Param 53 | Plan No XX - Param 54 | |
| 28 | 30528 | | Plan No XX - Param 55 | Plan No XX - Param 56 | |
| 29 | 30529 | | Plan No XX - Param 57 | Plan No XX - Param 58 | |
| 30 | 30530 | | Plan No XX - Param 59 | Plan No XX - Param 60 | |
| 31 | 30531 | | Plan No XX - Param 61 | Plan No XX - Param 62 | |
| 32 | 30532 | | Plan No XX - Param | Plan No XX - Param | |



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| | | | | | |
|---|---|---|---|---|---|
| | | | 63 | 64 | |
| 33 | 30533 | | Plan No XX - Param 65 | Plan No XX - Param 66 | |
| 34 | 30534 | | Plan No XX - Param 67 | Plan No XX - Param 68 | |
| 35 | 30535 | | Plan No XX - Param 69 | Plan No XX - Param 70 | |
| 36 | 30536 | | Plan No XX - Param 71 | Plan No XX - Param 72 | |
| 37 | 30537 | | Plan No XX - Param 73 | Plan No XX - Param 74 | |
| 38 | 30538 | | Plan No XX - Param 75 | Plan No XX - Param 76 | |
| 39 | 30539 | | Plan No XX - Param 77 | Plan No XX - Param 78 | |
| 40 | 30540 | | Plan No XX - Param 79 | Plan No XX - Param 80 | |
| 41 | 30541 | | Plan No XX - Param 81 | Plan No XX - Param 82 | |
| 42 | 30542 | | Plan No XX - Param 83 | Plan No XX - Param 84 | |
| 43 | 30543 | | Plan No XX - Param 85 | Plan No XX - Param 86 | |
| 44 | 30544 | | Plan No XX - Param 87 | Plan No XX - Param 88 | |
| 45 | 30545 | | Plan No XX - Param 89 | Plan No XX - Param 90 | |
| 46 | 30546 | | Plan No XX - Param 91 | Plan No XX - Param 92 | |
| 47 | 30547 | | Plan No XX - Param 93 | Plan No XX - Param 94 | |
| 48 | 30548 | | Plan No XX - Param 95 | Plan No XX - Param 96 | |
| 49 | 30549 | | Plan No XX - Param 97 | Plan No XX - Param 98 | |
| 50 | 30550 | | Plan No XX - Param 99 | Plan No XX - Param 100 | |



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*Table 14 - Reading - Plan information (Parameters 101-200)*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 51 | 30551 | | Plan No XX - Param 101 | Plan No XX - Param 102 | |
| 52 | 30552 | | Plan No XX - Param 103 | Plan No XX - Param 104 | |
| 53 | 30553 | | Plan No XX - Param 105 | Plan No XX - Param 106 | |
| 54 | 30554 | | Plan No XX - Param 107 | Plan No XX - Param 108 | |
| 55 | 30555 | | Plan No XX - Param 109 | Plan No XX - Param 110 | |
| 56 | 30556 | | Plan No XX - Param 111 | Plan No XX - Param 112 | |
| 57 | 30557 | | Plan No XX - Param 113 | Plan No XX - Param 114 | |
| 58 | 30558 | | Plan No XX - Param 115 | Plan No XX - Param 116 | |
| 59 | 30559 | | Plan No XX - Param 117 | Plan No XX - Param 118 | |
| 60 | 30560 | | Plan No XX - Param 119 | Plan No XX - Param 120 | |
| 61 | 30561 | | Plan No XX - Param 121 | Plan No XX - Param 122 | |
| 62 | 30562 | | Plan No XX - Param 123 | Plan No XX - Param 124 | |
| 63 | 30563 | | Plan No XX - Param 125 | Plan No XX - Param 126 | |
| 64 | 30564 | | Plan No XX - Param 127 | Plan No XX - Param 128 | |
| 65 | 30565 | | Plan No XX - Param 129 | Plan No XX - Param 130 | |
| 66 | 30566 | | Plan No XX - Param 131 | Plan No XX - Param 132 | |
| 67 | 30567 | | Plan No XX - Param 133 | Plan No XX - Param 134 | |
| 68 | 30568 | | Plan No XX - Param 135 | Plan No XX - Param 136 | |
| 69 | 30569 | | Plan No XX - Param 137 | Plan No XX - Param 138 | |
| 70 | 30570 | | Plan No XX - Param 139 | Plan No XX - Param 140 | |
| 71 | 30571 | | Plan No XX - Param 141 | Plan No XX - Param 142 | |
| 72 | 30572 | | Plan No XX - Param 143 | Plan No XX - Param 144 | |
| 73 | 30573 | | Plan No XX - Param 145 | Plan No XX - Param 146 | |
| 74 | 30574 | | Plan No XX - Param 147 | Plan No XX - Param 148 | |
| 75 | 30575 | | Plan No XX - Param 149 | Plan No XX - Param 150 | |
| 76 | 30576 | | Plan No XX - Param 151 | Plan No XX - Param 152 | |
| 77 | 30577 | | Plan No XX - Param 153 | Plan No XX - Param 154 | |
| 78 | 30578 | | Plan No XX - Param 155 | Plan No XX - Param 156 | |
| 79 | 30579 | | Plan No XX - Param 157 | Plan No XX - Param 158 | |
| 80 | 30580 | | Plan No XX - Param 159 | Plan No XX - Param 160 | |
| 81 | 30581 | | Plan No XX - Param 161 | Plan No XX - Param 162 | |
| 82 | 30582 | | Plan No XX - Param | Plan No XX - Param | |



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| | | | | | |
|---|---|---|---|---|---|
| | | | 163 | 164 | |
| 83 | 30583 | | Plan No XX - Param 165 | Plan No XX - Param 166 | |
| 84 | 30584 | | Plan No XX - Param 167 | Plan No XX - Param 168 | |
| 85 | 30585 | | Plan No XX - Param 169 | Plan No XX - Param 170 | |
| 86 | 30586 | | Plan No XX - Param 171 | Plan No XX - Param 172 | |
| 87 | 30587 | | Plan No XX - Param 173 | Plan No XX - Param 174 | |
| 88 | 30588 | | Plan No XX - Param 175 | Plan No XX - Param 176 | |
| 89 | 30589 | | Plan No XX - Param 177 | Plan No XX - Param 178 | |
| 90 | 30590 | | Plan No XX - Param 179 | Plan No XX - Param 180 | |
| 91 | 30591 | | Plan No XX - Param 181 | Plan No XX - Param 182 | |
| 92 | 30592 | | Plan No XX - Param 183 | Plan No XX - Param 184 | |
| 93 | 30593 | | Plan No XX - Param 185 | Plan No XX - Param 186 | |
| 94 | 30594 | | Plan No XX - Param 187 | Plan No XX - Param 188 | |
| 95 | 30595 | | Plan No XX - Param 189 | Plan No XX - Param 190 | |
| 96 | 30596 | | Plan No XX - Param 191 | Plan No XX - Param 192 | |
| 97 | 30597 | | Plan No XX - Param 193 | Plan No XX - Param 194 | |
| 98 | 30598 | | Plan No XX - Param 195 | Plan No XX - Param 196 | |
| 99 | 30599 | | Plan No XX - Param 197 | Plan No XX - Param 198 | |
| 100 | 30600 | | Plan No XX - Param 199 | Plan No XX - Param 200 | |



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*Table 16 – Writing – working instructions*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 1 | 40011 | | Real time clock - Year | Real time clock - Month | |
| 2 | 40012 | | Real time clock - Day of month | Real time clock - Hour | |
| 3 | 40013 | | Real time clock - Minute | Real time clock - Second | |
| 4 | 40014 | 1 | ON / OFF – פקודה | | Writing status |
| | | 2 | Command – PRCC mode | | To both Signalized Intersections |
| | | 3 | Command – SYCC mode | | To both Signalized intersections |
| | | 4 | Command – Blinking master | | For master Signalized Intersection |
| | | 5 | Command – Blinking secondary | | For secondary Signalized Intersection |
| | | 6 | Command – turn on/off the Illuminated Guidance Traffic Sign | | To both Signalized intersections |
| | | 7 | Reserved | | |
| | | 8 | Reserved | | |
| | | 9 | Command – Manual control mode | | To both Signalized intersections |
| | | 10 | Command – manual forward the plan | | To both Signalized Intersections |
| | | 11 | Reserved | | |
| | | 12 | Reserved | | |
| | | 13 | Reserved | | |
| | | 14 | Reserved | | |
| | | 15 | Reserved | | |
| | | 16 | Reserved | | |
| 5 | 40015 | | Writing - Traffic Light Timing Plan to run | | |
| 6 | 40016 | | Force detectors 1-8 | Force detectors 9-16 | |
| 7 | 40017 | | Force detectors 17-22 | Reserved | |
| 8 | 40018 | | Reserved | | |
| 9 | 40019 | | Reserved | | |
| 10 | 40020 | | Reserved | | |



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*Table 17 – Writing – Plan parameters (1-100)*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 0 | 40100 | | Traffic Light Timing Plan number | | |
| 1 | 40101 | | Plan No XX - Param 1 | Plan No XX - Param 2 | |
| 2 | 40102 | | Plan No XX - Param 3 | Plan No XX - Param 4 | |
| 3 | 40103 | | Plan No XX - Param 5 | Plan No XX - Param 6 | |
| 4 | 40104 | | Plan No XX - Param 7 | Plan No XX - Param 8 | |
| 5 | 40105 | | Plan No XX - Param 9 | Plan No XX - Param 10 | |
| 6 | 40106 | | Plan No XX - Param 11 | Plan No XX - Param 12 | |
| 7 | 40107 | | Plan No XX - Param 13 | Plan No XX - Param 14 | |
| 8 | 40108 | | Plan No XX - Param 15 | Plan No XX - Param 16 | |
| 9 | 40109 | | Plan No XX - Param 17 | Plan No XX - Param 18 | |
| 10 | 40110 | | Plan No XX - Param 19 | Plan No XX - Param 20 | |
| 11 | 40111 | | Plan No XX - Param 21 | Plan No XX - Param 22 | |
| 12 | 40112 | | Plan No XX - Param 23 | Plan No XX - Param 24 | |
| 13 | 40113 | | Plan No XX - Param 25 | Plan No XX - Param 26 | |
| 14 | 40114 | | Plan No XX - Param 27 | Plan No XX - Param 28 | |
| 15 | 40115 | | Plan No XX - Param 29 | Plan No XX - Param 30 | |
| 16 | 40116 | | Plan No XX - Param 31 | Plan No XX - Param 32 | |
| 17 | 40117 | | Plan No XX - Param 33 | Plan No XX - Param 34 | |
| 18 | 40118 | | Plan No XX - Param 35 | Plan No XX - Param 36 | |
| 19 | 40119 | | Plan No XX - Param 37 | Plan No XX - Param 38 | |
| 20 | 40120 | | Plan No XX - Param 39 | Plan No XX - Param 40 | |
| 21 | 40121 | | Plan No XX - Param 41 | Plan No XX - Param 42 | |
| 22 | 40122 | | Plan No XX - Param 43 | Plan No XX - Param 44 | |
| 23 | 40123 | | Plan No XX - Param 45 | Plan No XX - Param 46 | |
| 24 | 40124 | | Plan No XX - Param 47 | Plan No XX - Param 48 | |
| 25 | 40125 | | Plan No XX - Param 49 | Plan No XX - Param 50 | |
| 26 | 40126 | | Plan No XX - Param 51 | Plan No XX - Param 52 | |
| 27 | 40127 | | Plan No XX - Param 53 | Plan No XX - Param 54 | |
| 28 | 40128 | | Plan No XX - Param 55 | Plan No XX - Param 56 | |
| 29 | 40129 | | Plan No XX - Param 57 | Plan No XX - Param 58 | |
| 30 | 40130 | | Plan No XX - Param 59 | Plan No XX - Param 60 | |
| 31 | 40131 | | Plan No XX - Param 61 | Plan No XX - Param 62 | |
| 32 | 40132 | | Plan No XX - Param 63 | Plan No XX - Param 64 | |
| 33 | 40133 | | Plan No XX - Param 65 | Plan No XX - Param 66 | |
| 34 | 40134 | | Plan No XX - Param 67 | Plan No XX - Param 68 | |
| 35 | 40135 | | Plan No XX - Param 69 | Plan No XX - Param 70 | |
| 36 | 40136 | | Plan No XX - Param 71 | Plan No XX - Param 72 | |
| 37 | 40137 | | Plan No XX - Param 73 | Plan No XX - Param 74 | |
| 38 | 40138 | | Plan No XX - Param 75 | Plan No XX - Param 76 | |
| 39 | 40139 | | Plan No XX - Param 77 | Plan No XX - Param 78 | |
| 40 | 40140 | | Plan No XX - Param 79 | Plan No XX - Param 80 | |
| 41 | 40141 | | Plan No XX - Param 81 | Plan No XX - Param 82 | |
| 42 | 40142 | | Plan No XX - Param 83 | Plan No XX - Param 84 | |
| 43 | 40143 | | Plan No XX - Param 85 | Plan No XX - Param 86 | |
| 44 | 40144 | | Plan No XX - Param 87 | Plan No XX - Param 88 | |
| 45 | 40145 | | Plan No XX - Param 89 | Plan No XX - Param 90 | |
| 46 | 40146 | | Plan No XX - Param 91 | Plan No XX - Param 92 | |
| 47 | 40147 | | Plan No XX - Param 93 | Plan No XX - Param 94 | |
| 48 | 40148 | | Plan No XX - Param 95 | Plan No XX - Param 96 | |



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| | | | | | |
|---|---|---|---|---|---|
| 49 | 40149 | | Plan No XX - Param 97 | Plan No XX - Param 98 | |
| 50 | 40150 | | Plan No XX - Param 99 | Plan No XX - Param 100 | |

*Table 18 – Writing – Plan parameters (101-200)*

| # | Modbus | | Description - Location - LSB | Description - Location - MSB | Remarks |
|---|---|---|---|---|---|
| 51 | 40151 | | Plan No XX - Param 101 | Plan No XX - Param 102 | |
| 52 | 40152 | | Plan No XX - Param 103 | Plan No XX - Param 104 | |
| 53 | 40153 | | Plan No XX - Param 105 | Plan No XX - Param 106 | |
| 54 | 40154 | | Plan No XX - Param 107 | Plan No XX - Param 108 | |
| 55 | 40155 | | Plan No XX - Param 109 | Plan No XX - Param 110 | |
| 56 | 40156 | | Plan No XX - Param 111 | Plan No XX - Param 112 | |
| 57 | 40157 | | Plan No XX - Param 113 | Plan No XX - Param 114 | |
| 58 | 40158 | | Plan No XX - Param 115 | Plan No XX - Param 116 | |
| 59 | 40159 | | Plan No XX - Param 117 | Plan No XX - Param 118 | |
| 60 | 40160 | | Plan No XX - Param 119 | Plan No XX - Param 120 | |
| 61 | 40161 | | Plan No XX - Param 121 | Plan No XX - Param 122 | |
| 62 | 40162 | | Plan No XX - Param 123 | Plan No XX - Param 124 | |
| 63 | 40163 | | Plan No XX - Param 125 | Plan No XX - Param 126 | |
| 64 | 40164 | | Plan No XX - Param 127 | Plan No XX - Param 128 | |
| 65 | 40165 | | Plan No XX - Param 129 | Plan No XX - Param 130 | |
| 66 | 40166 | | Plan No XX - Param 131 | Plan No XX - Param 132 | |
| 67 | 40167 | | Plan No XX - Param 133 | Plan No XX - Param 134 | |
| 68 | 40168 | | Plan No XX - Param 135 | Plan No XX - Param 136 | |
| 69 | 40169 | | Plan No XX - Param 137 | Plan No XX - Param 138 | |
| 70 | 40170 | | Plan No XX - Param 139 | Plan No XX - Param 140 | |
| 71 | 40171 | | Plan No XX - Param 141 | Plan No XX - Param 142 | |
| 72 | 40172 | | Plan No XX - Param 143 | Plan No XX - Param 144 | |
| 73 | 40173 | | Plan No XX - Param 145 | Plan No XX - Param 146 | |
| 74 | 40174 | | Plan No XX - Param 147 | Plan No XX - Param 148 | |
| 75 | 40175 | | Plan No XX - Param 149 | Plan No XX - Param 150 | |
| 76 | 40176 | | Plan No XX - Param 151 | Plan No XX - Param 152 | |



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| | | | | | |
|---|---|---|---|---|---|
| 77 | 40177 | | Plan No XX - Param 153 | Plan No XX - Param 154 | |
| 78 | 40178 | | Plan No XX - Param 155 | Plan No XX - Param 156 | |
| 79 | 40179 | | Plan No XX - Param 157 | Plan No XX - Param 158 | |
| 80 | 40180 | | Plan No XX - Param 159 | Plan No XX - Param 160 | |
| 81 | 40181 | | Plan No XX - Param 161 | Plan No XX - Param 162 | |
| 82 | 40182 | | Plan No XX - Param 163 | Plan No XX - Param 164 | |
| 83 | 40183 | | Plan No XX - Param 165 | Plan No XX - Param 166 | |
| 84 | 40184 | | Plan No XX - Param 167 | Plan No XX - Param 168 | |
| 85 | 40185 | | Plan No XX - Param 169 | Plan No XX - Param 170 | |
| 86 | 40186 | | Plan No XX - Param 171 | Plan No XX - Param 172 | |
| 87 | 40187 | | Plan No XX - Param 173 | Plan No XX - Param 174 | |
| 88 | 40188 | | Plan No XX - Param 175 | Plan No XX - Param 176 | |
| 89 | 40189 | | Plan No XX - Param 177 | Plan No XX - Param 178 | |
| 90 | 40190 | | Plan No XX - Param 179 | Plan No XX - Param 180 | |
| 91 | 40191 | | Plan No XX - Param 181 | Plan No XX - Param 182 | |
| 92 | 40192 | | Plan No XX - Param 183 | Plan No XX - Param 184 | |
| 93 | 40193 | | Plan No XX - Param 185 | Plan No XX - Param 186 | |
| 94 | 40194 | | Plan No XX - Param 187 | Plan No XX - Param 188 | |
| 95 | 40195 | | Plan No XX - Param 189 | Plan No XX - Param 190 | |
| 96 | 40196 | | Plan No XX - Param 191 | Plan No XX - Param 192 | |
| 97 | 40197 | | Plan No XX - Param 193 | Plan No XX - Param 194 | |
| 98 | 40198 | | Plan No XX - Param 195 | Plan No XX - Param 196 | |
| 99 | 40199 | | Plan No XX - Param 197 | Plan No XX - Param 198 | |
| 100 | 40200 | | Plan No XX - Param 199 | Plan No XX - Param 200 | |



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## Appendix 7 – Maintenance system interface protocol

# Interface Specification
# UTC-RMS

## Contents





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# 1. INTRODUCTION

## 1.1 Purpose of the Document

The purpose of this document is to provide design specifications for the UTC to RMS System Interface for the Netivey Ayalon Road Management System project.

This is the Initial Design of the interface. Once approved, this document will be the basis for its development.

Note: In the event of any discrepancy in understanding the requirement or scope, the content may evolve in future revisions (while still complying with contract requirements).

## 1.2 Scope of the Document

To cover Incoming data resolution, define the interface method and purpose for the UTC and the RMS systems.

## 1.3 Definitions and Abbreviations

| Acronym | Definition |
|---|---|
| OCN | Operations Communications Network |
| RMS | Road Management System |
| UTC | Urban traffic management control |
| TCP/IP | Transmission Control Protocol/Internet Protocol |
| WAN | Wide Area Network |
| WS | Web Service |



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# 2. General Description

## 2.1 Interface Description

The interface between the UTC and the RMS will deliver Faults / Malfunctions with maintenance implications, as will be determined by the operator, into the RMS for start of Maintenance/Event process.

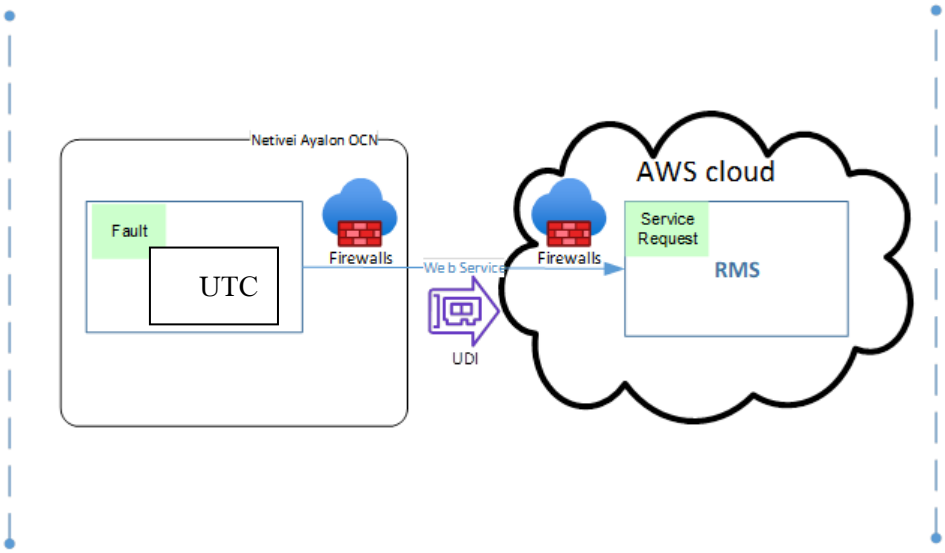


Figure 1 RMS-UTC interface Scheme

The incoming Faults / Malfunctions will be managed as "Service Requests" in the RMS, these "Service Requests" are the initial entity of the breakdown maintenance process.
For further information regarding 'Service Requests' in the RMS, please refer to RMS PDR design document.



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# 3. Interface specification

## 3.1 General

The Interface spec will be via Web Service directly to the RMS Integration Server.
Below are the technical details describing the various fields, schemes and examples of the interface.

| | |
|---|---|
| Direction: | From UTC to RMS |
| Frequency: | Online |
| Method: | Web Service |
| Source: | UTC |
| Staging table: | None |
| Target table: | R5ContactRecords |
| File name: | None |
| File format: | JSON |
| Protocol | REST |



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## 3.2 Data Fields

| Field Name | Format | Mandatory | Target Field RMS | Target Field Web Service |
|---|---|---|---|---|
| Service Request Code<br>Constant 1 for creation.<br>CTR_CODE for update | Char(30) | + | CTR_CODE | CONTACTRECORDCODE |
| Fault unique ID | CHAR(80) | + | CTR_UDFCHAR08 | UDFCHAR08 |
| Equipment unique ID | CHAR(80) | + | CTR_OBJECT | EQUIPMENTCODE |
| Faulty equipment description | CHAR(80) | | CTR_ UDFCHAR10 | UDFCHAR10 |
| Fault description | CHAR(200) | + | CTR_REMARK | NOTES |
| Event time | DateTime | + | CTR_UDFDATE03 | AlertTime |
| Status =<br>'O' – open | CHAR(10) | + | CTR_STATUS | STATUSCODE |
| Source system=<br>'UTC' | CHAR(10) | + | CTR_CONTACTSOURCE | CONTACTSOURCE |
| Organization code = ‘O1’ | CHAR(10) | + | CTR_ORG | ORGANIZATIONID |
| Incident Type | CHAR(30) | + | CTR_SERVICEPROBLEM | SERVICEPROBLEMCODE |
| Priority | Char(8) | 5\4\3\2\1 | CTR_PRIORITY | PRIORITYCODE |
| COPYCOMMENTS=<br>“-“ | Char(1) | + | CTR_ COPYCOMMENTS | COPYCOMMENTS |
| Classification='MAINT' | Char(8) | + | CTR_CLASS | CLASSCODE |



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| | | | | |
|---|---|---|---|---|
| Alert type='ACT' | CHAR(10) | + | CTR_TYPE | TYPECODE |

Restful API documentation can be reviewed here:

https://docs.hexagonali.com/r/en-US/HxGN-EAM-Rest-Web-Services/1272564

The Service Request WS description can be found here under operations→call center:

https://eam.eu1.inforcloudsuite.com/web/swagger/index.html#

There are 3 Web Services:

| **Method** | **Purpose** | **Description** |
|---|---|---|
| Post | Add Contact Record | Add new service request to RMS |
| Get | Get Contact Record | Get service request data from RMS |
| Put | Sync Contact Record | Update existing service request to RMS.<br>In order to update an alert, one must get all data using Get WS, and fill all the fields in the sync Put WS. |

## 4. Fault List - TBD



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# Appendix 8 – LISA traffic Light Timing Plan parameters definitions

| Parameter Order | GroupName | Parameter (TCS Name) | Mandatory in Avivim | Parameter description | [Units] |
|---|---|---|---|---|---|
| 1 | General | GreenWaveOffset | Defined in Avivim | Green wave Offset defined to slave junction in rigid coordination.Green Wave settings are defined manually in Avivim | seconds |
| 2 | | pPedMaxRed | No | Maximum red Time allowance for pedestrians | seconds |
| 3 | | pCycleTime | Yes | Maximum allowed cycle time | seconds |
| 4 | | StructureNo | Yes, Defined in Avivim | Definition of the logic applied in a specific program | whole number |
| 5 | | IsMaster | Defined in Avivim | 0- Master 1- Slave. Green Wave settings are defined manually in Avivim | 0/1 |
| 6 | Simple stages minimum (up to 10 Simple stages) | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | Yes (for each defined simple stage) | Minimum duration of Simple stage X / Minimum end cycle time of Simple stage X / Special Minimum time of Simple stage X | seconds |
| 7 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 8 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 9 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 10 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 11 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 12 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 13 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 14 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 15 | | pMinDuration_X /pMinEndTime _ X / pMinSpecial_X | | | |
| 16 | Simple stages maximum (up to 10 Simple stages) | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | Yes (for each defined simple stage) | Maximum duration of complex stage X / Maximum end cycle time of complex stage X / Special Maximum time of complex stage X | seconds |
| 17 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 18 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 19 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |



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| Parameter Order | GroupName | Parameter (TCS Name) | Mandatory in Avivim | Parameter description | [Units] |
|---|---|---|---|---|---|
| 20 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 21 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 22 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 23 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 24 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 25 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 26 | Complex stages minimum (up to 15 complex stages) | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | Yes (for each defined Complex stage) | Minimum duration of complex stage X / Minimum end cycle time of complex stage X / Special Minimum time of complex stage X | seconds |
| 27 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 28 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 29 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 30 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 31 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 32 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 33 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 34 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 35 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 36 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 37 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 38 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 39 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |
| 40 | | pMinDuration_X / pMinEndTime _ X / pMinSpecial_X | | | |



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| Parameter Order | GroupName | Parameter (TCS Name) | Mandatory in Avivim | Parameter description | [Units] |
|---|---|---|---|---|---|
| 41 | Complex stages maximum (up to 15 complex stages) | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | Yes (for each defined Complex stage) | Maximum duration of complex stage X / Maximum end cycle time of complex stage X / Special Maximum time of complex stage X | Seconds |
| 42 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 43 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 44 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 45 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 46 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 47 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 48 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 49 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 50 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 51 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 52 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 53 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 54 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 55 | | pMaxDuration_X / pMaxEndTime _ X / pMaxSpecial_X | | | |
| 56 | Complex stages 2nd Maximum/Minimum (up to 15 complex stages) | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | Yes (for each defined Complex stage) | Additional Maximum duration of complex stage X / Maximum end cycle time of complex stage X / Special Maximum time of complex stage X / Minimum duration of complex stage X / Minimum end cycle time of complex stage X / Special Minimum time | |
| 57 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 58 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 59 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / | | | |



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| Parameter Order | GroupName | Parameter (TCS Name) | Mandatory in Avivim | Parameter description | [Units] |
|---|---|---|---|---|---|
| | | pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | of complex stage X | |
| 60 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 61 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 62 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 63 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 64 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 65 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 66 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 67 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 68 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 69 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 70 | | pExtraMaxDuration_X / pExtraMaxEndTime _ X / pExtraMaxSpecial_X / pExtraMinDuration_X / pExtraMinEndTime _ X / pExtraMinSpecial_X | | | |
| 71 | | pReqCumDuration_j | | | |



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| Parameter Order | GroupName | Parameter (TCS Name) | Mandatory in Avivim | Parameter description | [Units] |
|---|---|---|---|---|---|
| 72 | Compensation And Vehicle Maximum Red (up to 3 different Veh SGs) | pReqCumDuration_j | No | Compensation parameter- the minimum cumulated green time required for SG j **per two cycles** | |
| 73 | | pReqCumDuration_j | | | |
| 74 | | pVehMaxRed_j | | Maximum red Time allowance of vehicle SG j | |
| 75 | | pVehMaxRed_j | | | |
| 76 | | pVehMaxRed_j | | | |
| 77 | Queue detectors params | pMinOccup_Qj | No | Minimal time for queue detection. If the queue detector is occupied for more then pMinOccup Qj seconds, then queue is declared. | |
| 78 | | pMinOccup_Qj | | | |
| 79 | | pDeletionTime_Qj | | Minimal time for queue cancelation. If the queue detector is not occupied for more than pDeletionTime_Qj seconds, then queue declaration is cancelled. | |
| 80 | | pDeletionTime_Qj | | | |
| 81 | | pMaxOccup_Qj | | Minimal time for fault detector. If the occipation time of the queue detector is more than pMaxOccup_Qj seconds, then there is no queue declaration. | |
| 82 | | pMaxOccup_Qj | | | |
| 83 | Priority by SG (up to 4 PT SGs) | pPT_DirectionPriority_j | No | Priority definition to the specific direction SG j: 1 - SG j prioritrized according the functional order 0 - SG j is not prioritrized. | |
| 84 | | pPT_DirectionPriority_j | | | |
| 85 | | pPT_DirectionPriority_j | | | |
| 86 | | pPT_DirectionPriority_j | | | |
| 87 | Priority Flag | pPTpriorityFlag | No | 0-No Priority activities 1-Soft Priority activities will be implemented 2-Agresive Priority activities will be implemented | |
| 88 | PT arrival time | pAssumedTimeDL_j | | | |



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| Parameter Order | GroupName | Parameter (TCS Name) | Mandatory in Avivim | Parameter description | [Units] |
|---|---|---|---|---|---|
| 89 | | pAssumedTimeDL_j | No | Assumed time for far detector to stopping line for SG j | |
| 90 | | pAssumedTimeDL_j | | | |
| 91 | | pAssumedTimeDP_j | | Assumed time for near detector to stopping line for SG j | |
| 92 | | pAssumedTimeDP_j | | | |
| 93 | | pAssumedTimeDP_j | | | |
| 94 | PT Arrival Time Calibration | pPreviousBuses | No | Calibration parameter: Number of previous buses for actual average arrival time calculation. Single parameter for all PT SGs | whole number |
| 95 | | pStatError | | Calibration parameter: the maximum deviation allowed from the assumed arrival time of a single measurement for calibration | whole number |
| 96 | Reserved for future use | | | | |
| 97 | | | | | |
| 98 | | | - | - | |
| 99 | Detector Programs | pGap Set | No | Number of Gap values set (detector programm). Set of values is entered manually in Avivim | |
| 100 | | pMode Set | No | Number of Mode values set (detector programm). Set of values is entered manually in Avivim | |



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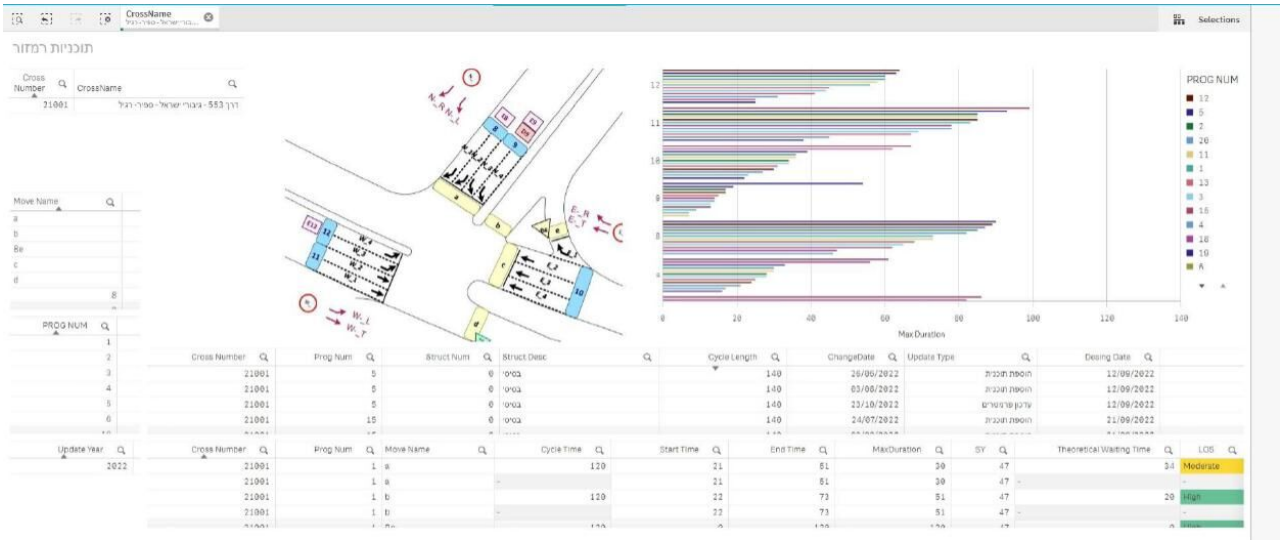
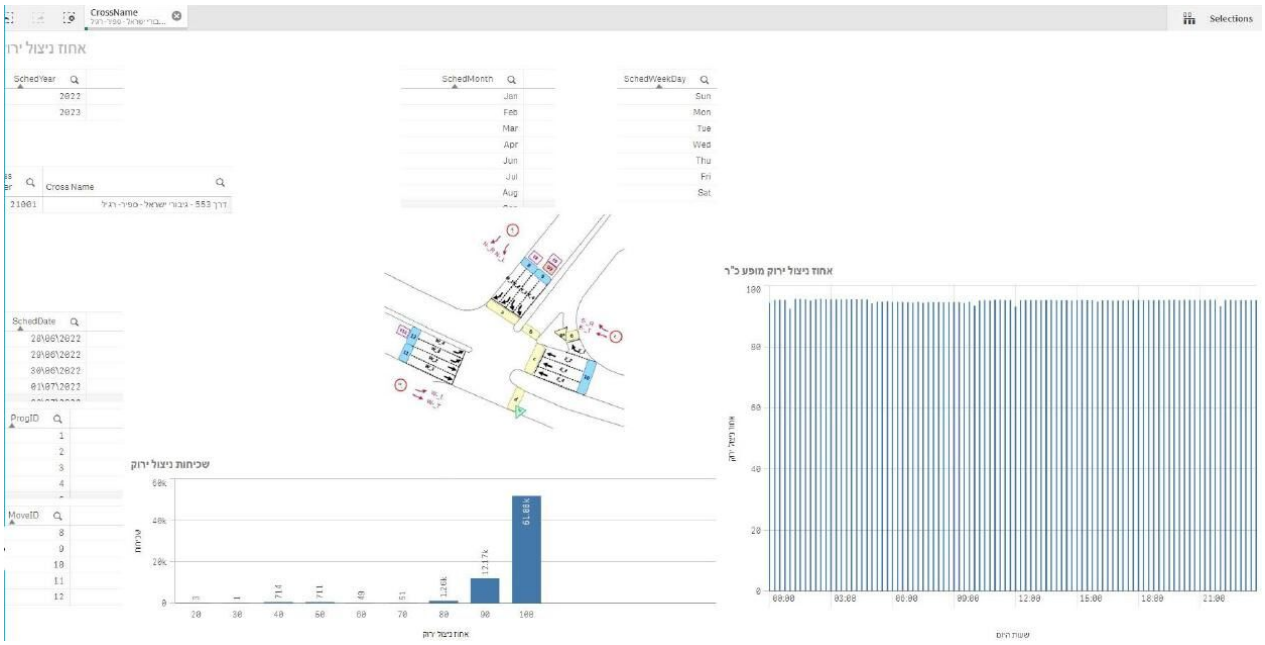
# Appendix 9 – BI Reports samples

## 9.1 Traffic Light Timing Plan report



## 9.2 Percentage and Frequency of Green Utilization report





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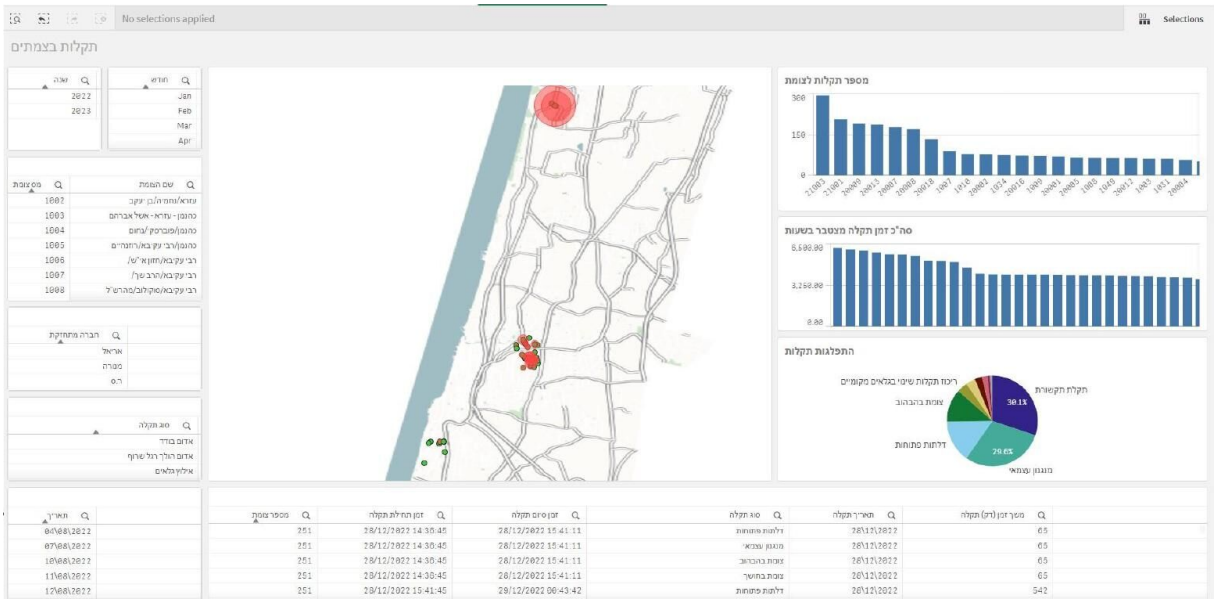
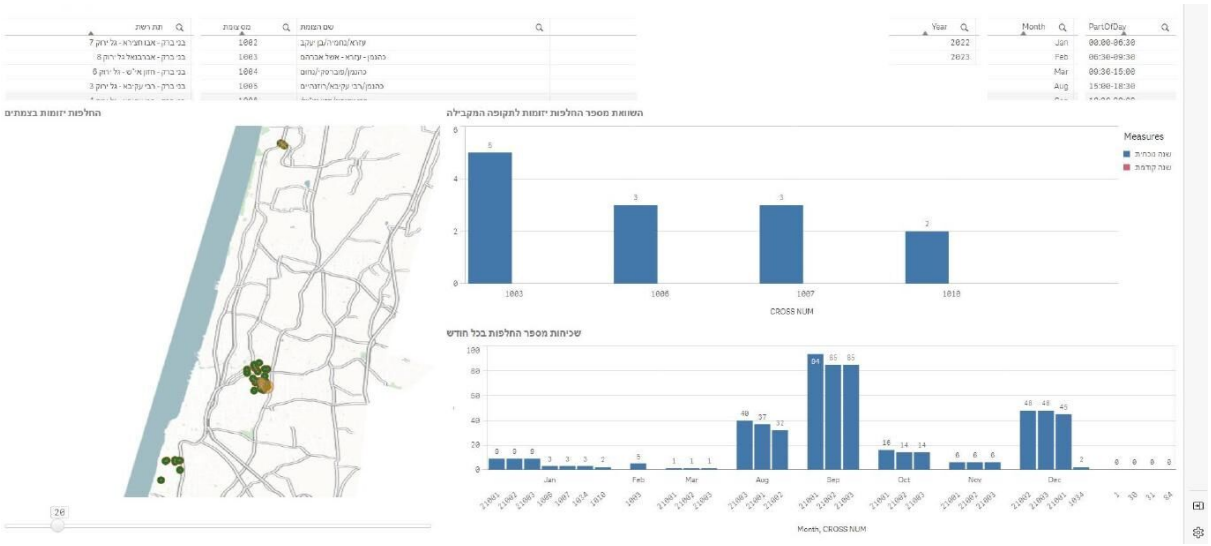
## 9.3 Traffic lights' alerts and faults report




## 9.4 Initiated changes in the active traffic light plan report



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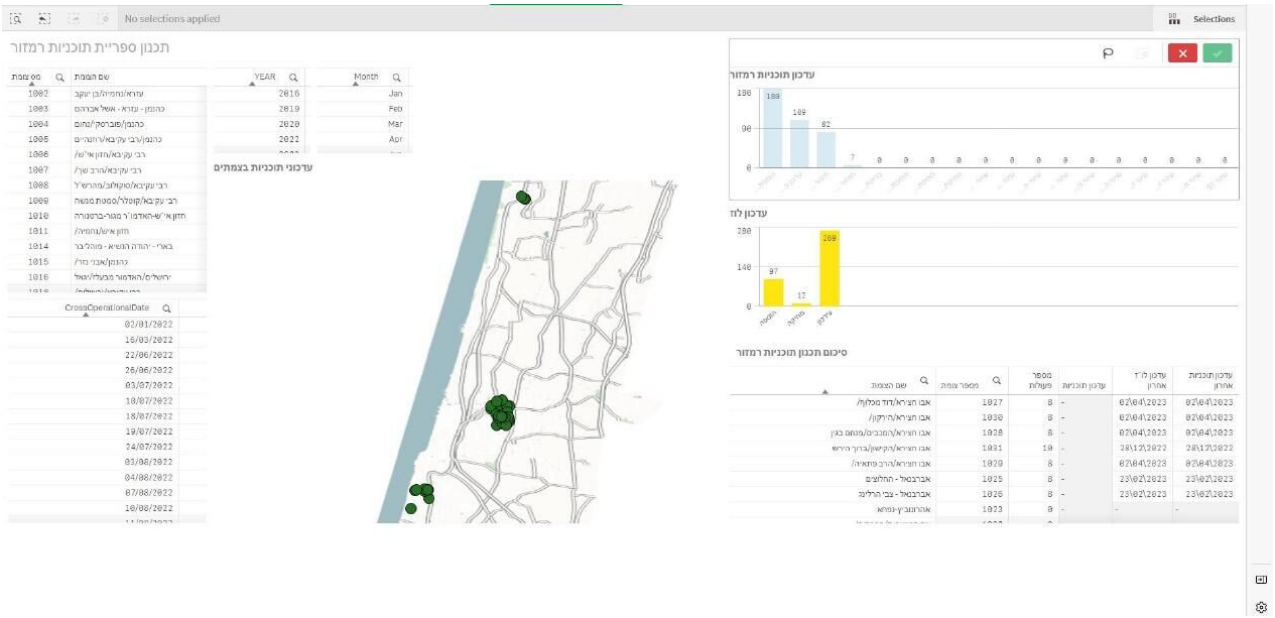
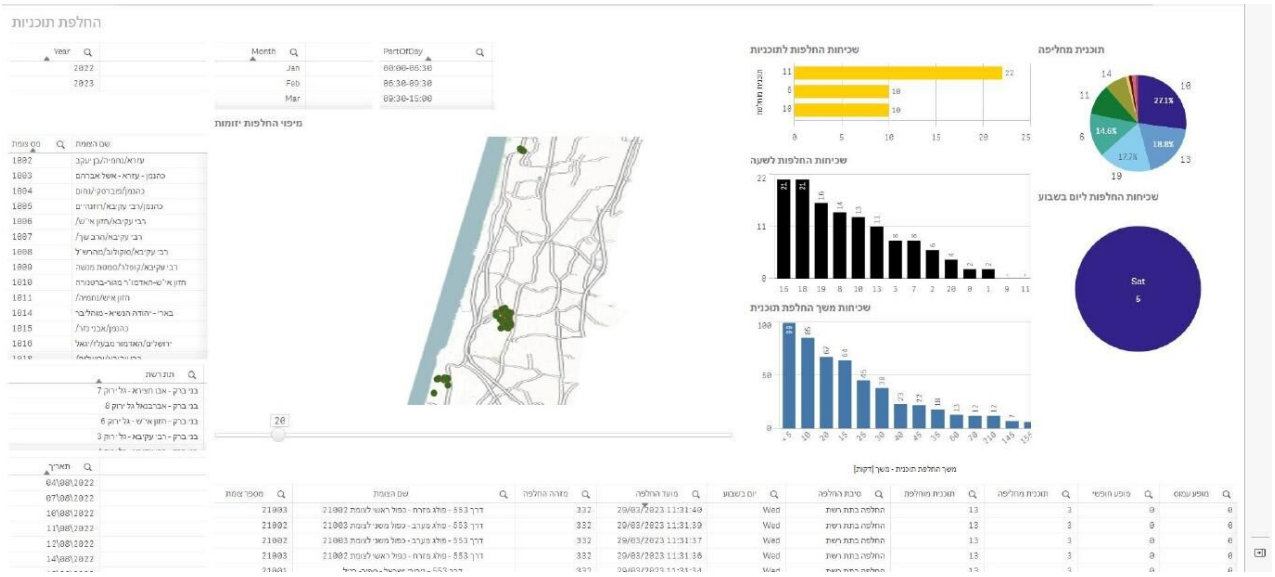
## 9.5 List of changes to the traffic light plans report



## 9.6 Changes of the active traffic light plan report





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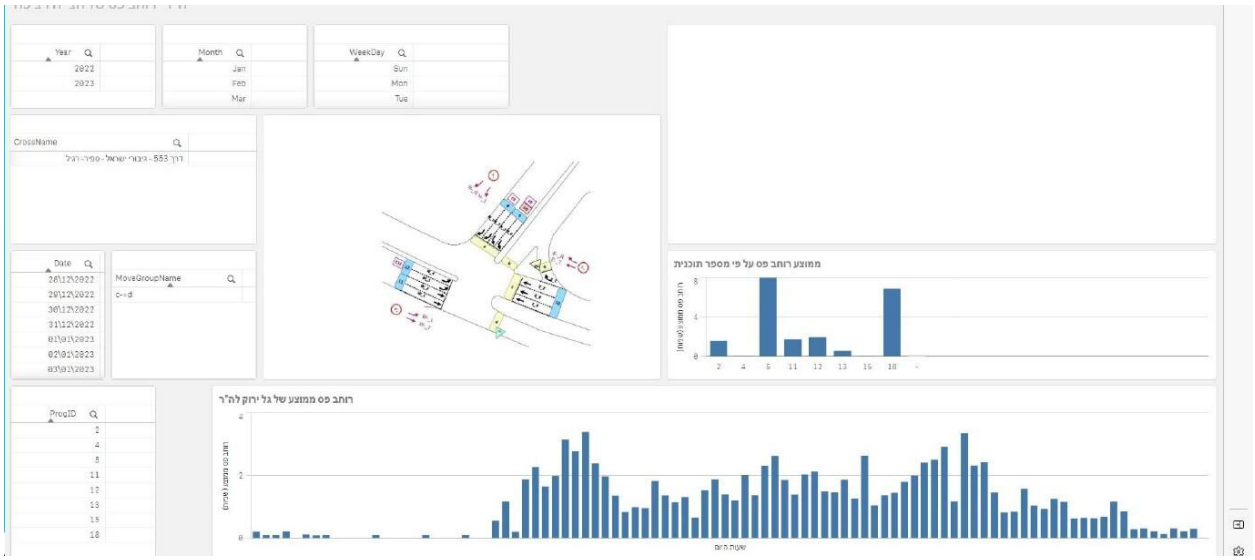
## 9.7 Pedestrian green for continuous crossing



## 9.8 Bus frequency by bus stop/station report



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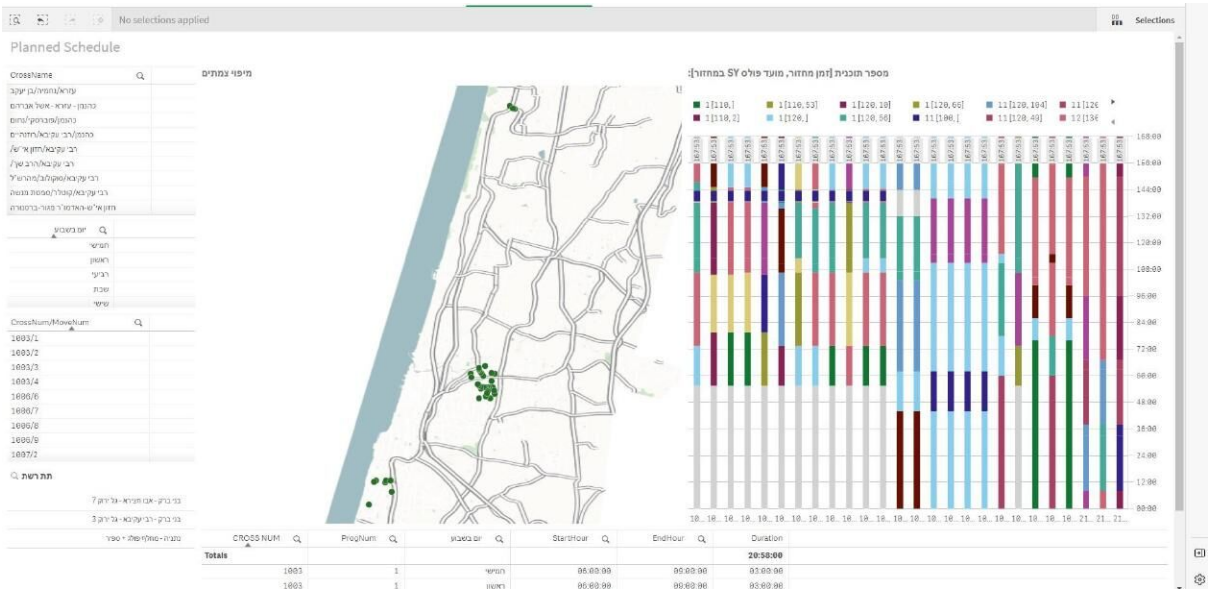
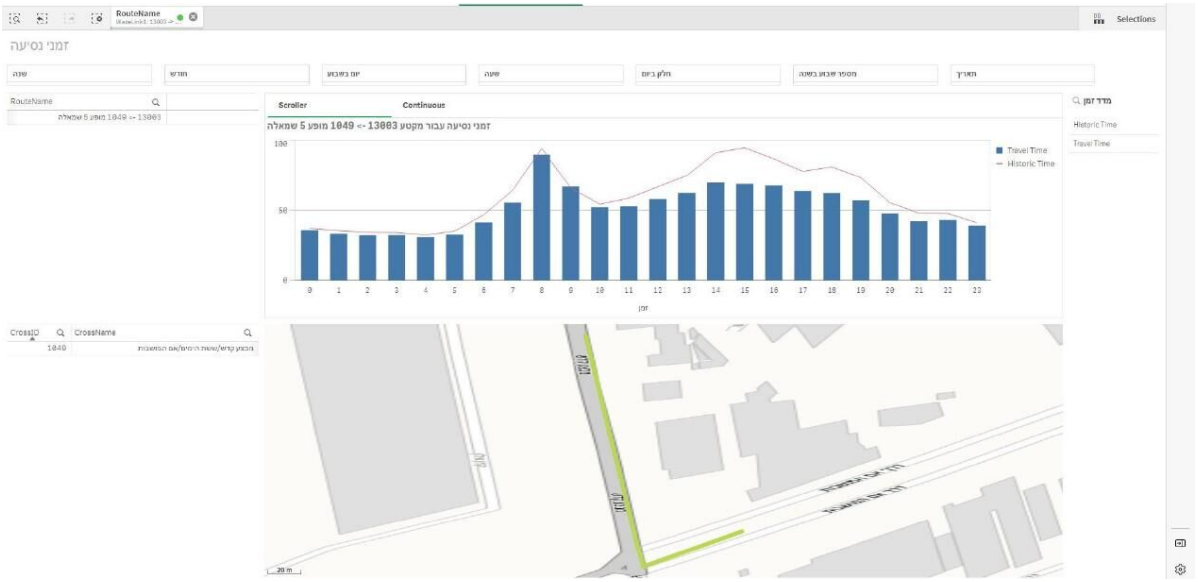
## 9.9 Schedule of green wave plans report




## 9.10 Waze raw data of travel duration report



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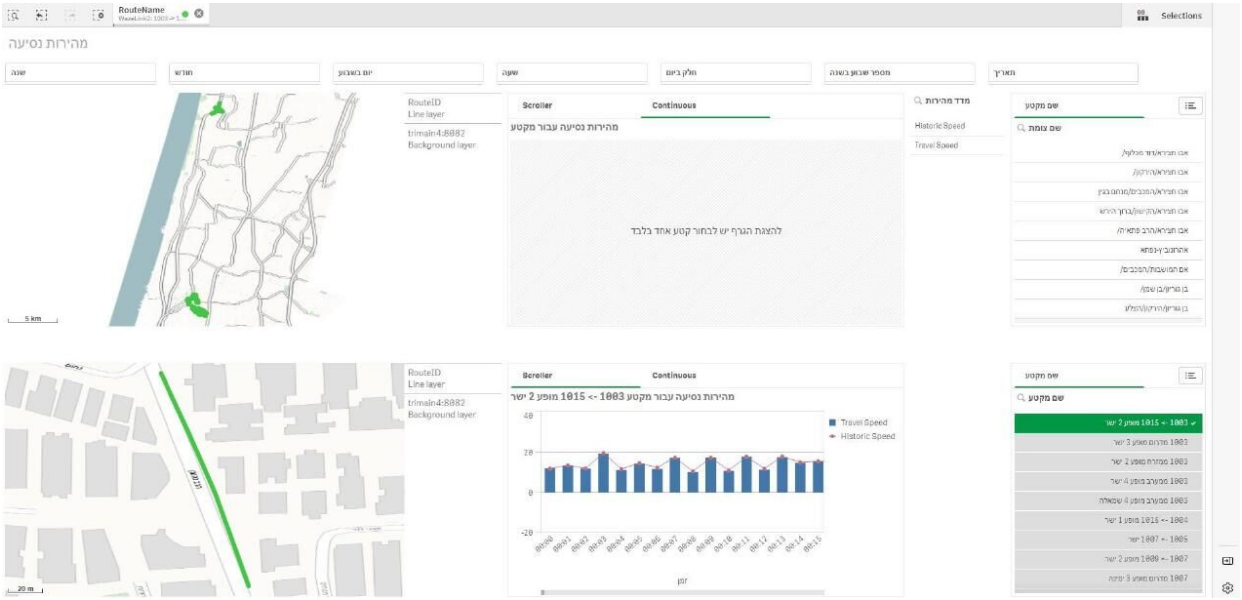
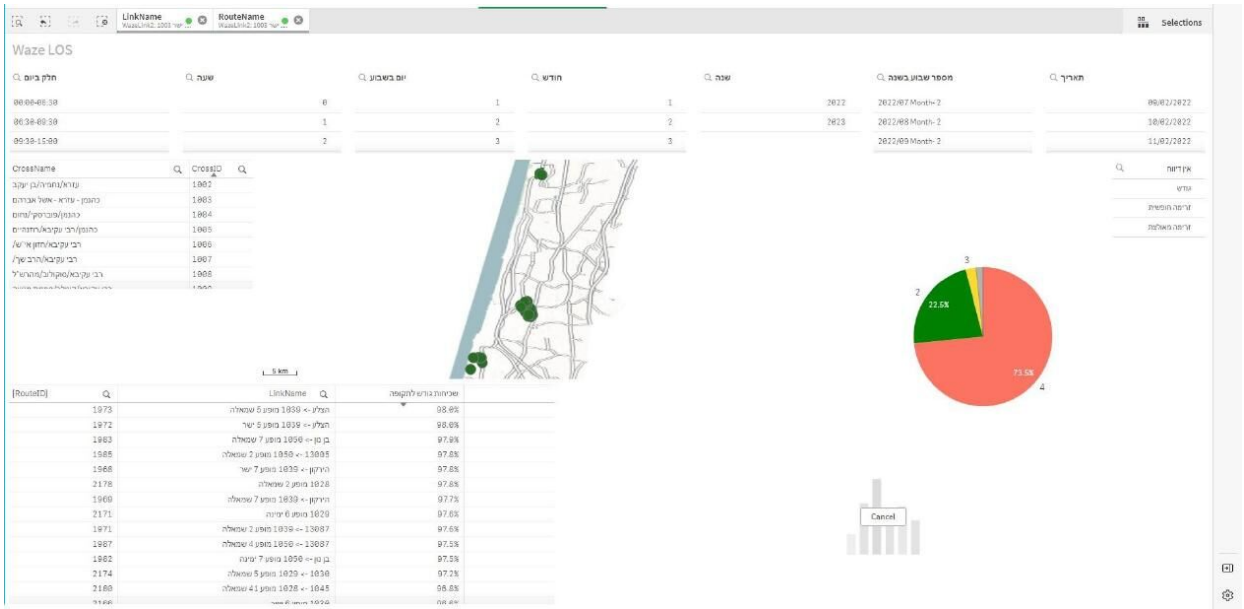
## 9.11 Travel speed by Waze report




## 9.12 Waze LOS report



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# Appendix 10 – Modular-Extensible Protocol MEP200802

Protocol definition

| | |
|---|---|
| Subject: | Definition of the Modular-Extensible Protocol |
| Aim: | Description of structure and usage of the Modular-Extensible Protocol by Aesys® |
| Version: | 0.15 |
| Authorization level: | RESERVED |

| | |
|---|---|
| Produced by: | AESYS S.p.A. |
| Date: | 03.02.2010 |
| Author(s): | [MR] Moris Ravasio (moris.ravasio@aesys.it) |
| Verified by: | [SS] Samuele Savoldelli (samuele.savoldelli@aesys.it)<br>[LB] Luca Bacis (luca.bacis@aesys.it)<br>[SV] Sergio Vismara (sergio.vismara@aesys.it) |

| | |
|---|---|
| Distribution list: | INTERNAL, CUSTOMERS |

| | |
|---|---|
| File name: | MEP200802_ProtocolDefinition_0_15.doc |

DOCUMENT HISTORY

| Version | Date | Author | Description |
|---|---|---|---|
| 0.11 | 23.09.2008 | MR | Added part error code 6 (operation not expected); added value 5 (driven by local console) to PUBLICATION_STATUS; |



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| | | | |
|---|---|---|---|
| | | | described the data structure returned by<br>BROKEN_LEDS_MAP |
| 0.12 | 09.10.2008 | MR | Added codes 00161 and 00162 |
| 0.13 | 30.04.2009 | MR | Added the description of drawing commands; added arrow/cross format for broken LEDs map |
| 0.14 | 06.08.2009 | MR | Added codes 24020, 24021, 35020 and 35021 (GSM management); added codes 22003, 31003, 31004, 31005 (siren management); added codes 10600, 10601, 10602 (GPS sensor management); fixed VIS_HTML_PAGES data structure (page index and page duration were swapped); added codes 23051 – 23054 (anti-tampering sensors) |
| 0.15 | 03.02.2010 | LB | Added codes 21000, 21021, 21022 and 21030 (cabinet door sensor, fuel level, battery charge level, AC connection) |

# 0 Introduction

Every time two devices have to communicate they have to agree on the protocol they will use to exchange data. A protocol is the set of rules the communications counterparts must obey in order to successfully transfer pieces of information between them. A protocol definition may be very complex, since a broad range of details may be involved in it.

From the beginning Aesys® defined a lot of protocols requested to drive the produced devices. Very often, these protocols were born following the creativity of the single programmer, and very often they are not interoperable. Even following releases of the same protocol are sometimes not compatible with previous ones.

In order to rationalize the matter, the Aesys® Modular Extensible Protocol (Aesys® MEP) has been defined, and this document is intended for its description.

MEP is:

modular, because it should be possible to isolate some parts of the protocol (that is some devices can implement only some features of the protocol);

extensible, because it should be possible to extend the protocol definition without impacting on existent protocol implementations (retro-compatibility of the protocol).

MEP locates itself at level 7 (application) of the ISO/OSI network stack, and its definition has been made in order to make it independent from underlying levels.



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However please consider that MEP was born with Aesys® devices in mind. So, even if it is possible to extend it for driving whatever system (even to rule the communication between two PCs, for example), maybe it should be not the best solution out of its standard application field.

## 1 Frame structure

Even if the protocol definition is independent from level 1-6 of the ISO/OSI network stack, two different frame structures are suggested, in order to avoid data redundancy. This is because two different application scenarios may exist:

Protected Point-to-Point (PPTP) connection, where the communication channel is established between two safely identified end-points and the channel is protected against transmission errors (think to TCP/IP connections as an example of this scenario);

Unprotected or Point-to-Broadcast (UoPTB) connection, where the communication channel is either unprotected against communication transfer errors or the channel links together several different devices to be addressed at application level (think to serial RS-485 connections as an example of this scenario).

UoPTB connections requires more information to be transferred with every protocol frame with respect to PPTP connections. Particularly there is the need to specify the frame destination address and checksum information together with the markers for frame beginning/ending (this implies the necessity to encode other frame parts for avoiding collisions with markers).

Figure 1 summarizes the structure of frames in PPTP and UoPTB scenarios.

Frame structure is designed to target an encoded maximum length of 16KB (16384 bytes) [devices implementing the MEP protocol should then allocate 16KB for both the TX and RX buffer). Since the encoding mechanism doubles the number of escaped bytes, the worst case is represented by the case in which all bytes being transferred need to be escaped, so the frame length doubles. This means that the actual maximum length of data (prior to encoding) is equal to 8183 bytes, supposing that the STX and ETX bytes are not stored within transmission buffers.

Even if PPTP scenario is not affected by the encoding problem, the maximum length of 8183 bytes is kept for uniformity.

As you can see PPTP frame is completely embedded within the UoPTB frame. So, once specific UoPTB level header and trailer have been processed, the remaining part of the frame can be successfully parsed by PPTP routines.



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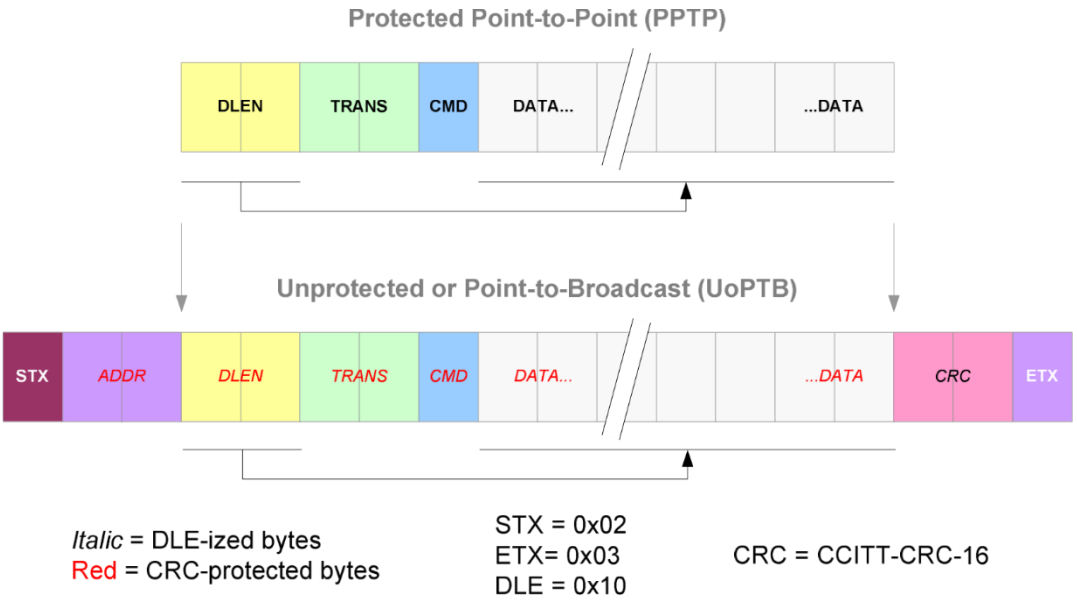


Figure 1: MEP Frame structure in PPTP and UoPTB scenarios

DLEN field (Data LENgth) always refers to length (in bytes) of DATA field, prior to encoding.

TRANS field (TRANSaction) is intended for hosting an identifier of the exchange occurring between the communication counterparts. This identifier allows the matching of an answer frame with the request frame by which it was generated. Usually the identifier should be generated by the communication master part as a progressive number, but its implementation is customizable case-by-case. Some applications may also decide to not use the identification of transactions; in such a case TRANS field should always be zero-ed.

ADDR is the logical address of the device; use value 0xFFFF for broadcasting messages to all connected devices (devices won't normally answer to broadcasted messages).

Numeric multi-bytes fields (like DLEN, TRANS or ADDR and CRC in UoPTB scenario) are always transmitted (leftto-right) starting from the most significant byte (MSB) to the least significant byte (LSB).

## 2 Running deep into UoPTB scenario

UoPTB scenario requires that frame beginning/ending are denoted by markers (byte STX for frame beginning and byte ETX for frame ending). This fact implies that other frame data are DLE-ized (=encoded) for avoiding collisions with markers. Frame parts subjected to DLE encoding are labeled in italic in Figure 1.

The encoding mechanism is quite simple. Every time bytes STX (0x02), ETX (0x03) or DLE (0x10) are encountered within fields subjected to encoding, they are replaced by DLE (0x10) followed by the byte being encoded incremented by 0x80. The following Table 1 shows all possible encodings.



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| Prior to encoding | | After encoding |
|---|---|---|
| Symbolic | Hexadecimal | |
| STX | [02] | [10][82] |
| ETX | [03] | [10][83] |
| DLE | [10] | [10][90] |
| other | [XX] | [XX] |

Table 1: UoPTB encoding rules Frame decoding requires the inverse data transformation.

UoPTB scenario also requires that transferred data are protected against transmission errors. The protection mechanism is provided by the computation of a CRC (Cyclic Redundancy Check) code transmitted together with data. The receiving part can compute the CRC of received data and compare the computed CRC with the received CRC. In case of mismatch the receiving part can infer that some errors occurred during transmission and can safely handle the case.

Fields subjected to the CRC computation are labeled red in Figure 1.

MEP makes use of CCITT-CRC-16 algorithm for CRC computation (generator polynomial fixed to 0x1021). List 1 reports the current implementation of the algorithm in use by MEP in standard ANSI C.

---

```
#define POLYGEN 0x1021

typedef HWORD unsigned short;
typedef BYTE unsigned char;

HWORD CalcCRC(BYTE *btBuffer, HWORD hwBuffSize)
{
HWORD hwCrc; hwCrc = 0xFFFF;
 for (HWORD i = 0; i < hwBuffSize; i++)
```



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```
{ hwCrc = hwCrc ^ ((HWORD)btBuffer[i] << 8);
 for (BYTE j = 0; j < 8; j++)
{ if (hwCrc & 0x8000) hwCrc = (hwCrc << 1) ^ POLYGEN;
else hwCrc <<= 1;
}
}
return(hwCrc);
}
```

List 1: CCITT-CRC-16 algorithm implementation

## 3 Protocol commands

The protocol bases its extensibility on the concept of data field (briefly "field"). Two counterparts communicate simply reading and/or writing some fields (each field is identified by its own code, agreed by the two parts).

Doing this way, only a few protocol commands are needed (namely those for reading/writing fields) since all the logic of the protocol resides in WHICH fields are written and/or read.

The field-based approach is particularly suited for reading, for example, the status of the device (it is sufficient to make a read of the proper set of fields) or to set the configuration of the device (by writing the proper set of fields). But this approach reveals itself quite simple even for launching some activity on the device: in this case the writing of some data to a particular field can initiate an operation on the device (data written to the field can represent in this case the parameters supplied as input to the operation; the structure of those data depends on the specific operation and MUST be defined together with the definition of the operation). It is also possible to read operation output parameters as a result of the write-to-field primitive (see DAT command for details).

Each field has its own type and size.

It is possible by the protocol to transfer the content of fields whose size is greater than MEP frame maximum length. Actually reading and writing operations always rely on the availability of the offset parameter, telling the counterpart at which byte of the field being handled the reading/writing operation must occur.

Protocol commands for reading/writing are multi-field, that is more than one field can be simultaneously read and or written at once, in an unique operation.

## 4 Commands



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Seven commands have been defined:

SET (0x80), for writing field content;

GET (0x81), for reading field content;

DEL (0x82), for completely erase field content;

DAT (0x83), for transferring answers deriving from the execution of SET, GET and DEL commands;

SETZ (0x84), for writing field content (data to be written are GZIP-compressed);

GETZ (0x85), for reading field content (read data must be returned by the device in GZIP compressed format);

DATZ (0x86), for transferring answers deriving from the execution of SETZ and GETZ commands (GZIP compressed version).

SET (0x80)

The SET command (hexadecimal code 0x80) is intended for writing the content of the specified fields. The SET command data payload is structured as depicted in Figure 2.

SET (0x80)

| | |
|---|---|
| **code** | **2** |
| **offset** | **4** |
| **length** | **2** |
| **data** | **any** |
| code | 2 |
| offset | 4 |
| length | 2 |
| data | any |

Figure 2: SET command data payload structure

The content of a field can be specified starting from a given offset.

The explicit specification of the length of a field allows the communication counterpart receiving the SET command to skip unknown fields (in the command execution report a warning will obviously be raised for skipped fields [see DAT command for details]).

SET command is multi-field, that is the setting of multiple fields can be specified in a single frame, enqueuing field data up to the maximum length of the frame.

GET (0x81)



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The GET command (hexadecimal code 0x81) is intended for reading the content of the specified fields. The GET command data payload is structured as depicted in Figure 3.

GET (0x81)

| | |
|---|---|
| **code** | **2** |
| **offset** | **4** |
| code | 2 |
| offset | 4 |

Figure 3: GET command data payload structure

Reading the content of a field can be executed starting from a given offset.

GET command is multi-field, that is the request for reading multiple fields can be specified in a single frame, enqueuing requests up to the maximum length of the frame.

The enquired device will answer returning requested data for known fields, and a warning message for unknown or unreadable fields [see DAT commands for details].

In order to save communication channel traffic, it is also possible to place a cumulative request, that is simply querying a field a set of field is returned rather than a single field only. This is particularly useful, for example, in querying a device status: we can simply read the value of a specific field and get as the response the whole set of fields representing the status of the device (fields having this behavior are marked by an asterisk in the field codes list). In such a case the set of fields returned by the device depends on the firmware implementation: it is up to the requester to parse all the returned fields in order to discover which ones it is interested in.

DEL (0x82)

The DEL command (hexadecimal code 0x82) completely deletes the content of the specified fields (setting their length to zero). DEL command is particularly useful before starting the upload of a long field (the field is deleted and then uploaded part-by-part). The DEL command data payload is structured as depicted in Figure 4.

DEL (0x82)

| | |
|---|---|
| **code** | **2** |
| code | 2 |

Figure 4: DEL command data payload structure



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DEL command is multi-field, that is the request for deleting multiple fields can be specified in a single frame, enqueuing requests up to the maximum length of the frame.

The enquired device will answer returning execution reports for all requested fields [see DAT commands for details].

DAT (0x83)

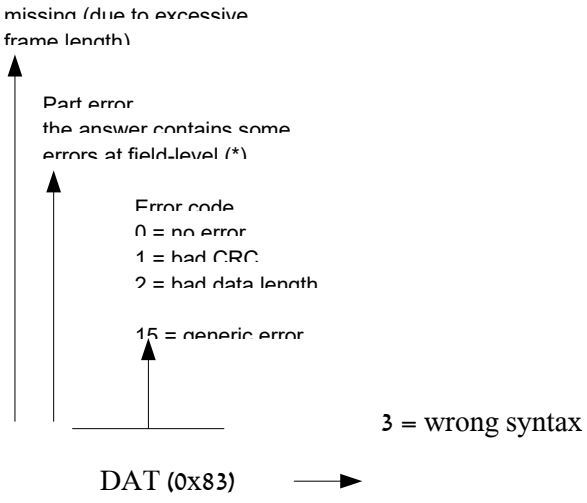
The DAT command (hexadecimal code 0x83) is emitted by a device following to a SET, GET or DEL request from the counterpart. The DAT command data payload is structured as depicted in Figure 5.

DAT command is multi-field, that is information related to several fields can be specified in a single frame, enqueuing requests up to the maximum length of the frame.

The first field in DAT command data payload is named status and contains the global status of the response to the previous SET, GET or DEL command. Looking at Figure 5 it is possible to locate the following information: bit 0 – 3 (EEEE): generic error code (see figure for allowed values); bit 4 (P): the frame contains some errors at part level (that is it has not been possible to SET, GET or DEL some of the requested fields: more info about the problem can be found looking at flags field for troubled field codes);

bit 5 (F): some requested codes have not been processed (due to the fact that the answer frame would have been too long); in this case the counterpart requesting SET, GET or DEL should parse the DAT frame in order to discover which field codes were not processed, and retry to perform the desired operation on missed fields.

Fragmented answer some requested codes are



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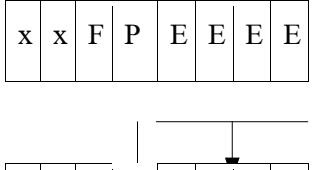
| | |
|---|---|
| status | 1 |
| code | 2 |
| offset | 4 |
| flags | 1 |
| length | 2 |
| data | any |
| code | 2 |
| offset | 4 |
| flags | 1 |
| length | 2 |
| data | any |

Error code (*)




0 = no error

1 = code does not exist

2 = offset does not exist

3 = cannot read/write

4 = wrong data length

5 = wrong data

6 = operation not expected

⋮

15 = generic error

More data more data exist beyond the requested index

Figure 5: DAT command data payload structure

After the status field, the sequence code, offset, flags, length and data repeats for every requested field.

Offset always repeats the offset value contained in the original SET or GET request, and it is always zero when answering DEL requests.

Particularly noticeable is the meaning of field flags which tell you the exit status on the operation requested on the field it refers to. Looking at Figure 5 it is possible to locate the following information:

bit 0 – 3 (EEEE): generic error code (see figure for allowed values); bit 4 (M): this bit is set only for GET requests, when the field being read has more data beyond the ones being returned by this DAT frame (this may occur for long fields); this bit has to be intended by the requester as an hint to proceed with reading more data on that field. Actually the reading from a long field should terminate when receiving a DAT frame where bit M is not set or when receiving a DAT frame where the part error code for the requested field is set to "2 = offset does not exist".



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The content of length and data depends on the requested operation.

when answering a SET operation:

- if the writing operation on the field has generated the execution of an operation, then following DAT command is used for returning output parameters of the invoked function (they will be hosted by data field, and length field will be set accordingly); however the format of returned data depends on the operation definition and must be specified together with the operation definition;
- if SET did not generate the execution of an operation and/or no output parameters have to be returned, then length will be zero and no data field will be transferred;

when answering a DEL operation, length is always zero and no data field is transferred; when answering a GET operation, length is the length of read data, which are contained in field data (so the length of data field is equal to length).

SETZ (0x84)

The SETZ command (hexadecimal code 0x84) is intended for writing the content of the specified fields. The SETZ command has the same structure and semantic of command SET (0x80), as described in Figure 2. The only difference is that the data part of the command is compressed using a standard GZIP algorithm, so when the device receives a SETZ command it simply uncompress the data part and stores uncompressed data at the given field offset.

ATTENTION: data offset are ALWAYS expressed referred to uncompressed data.

SETZ command is multi-field, that is the setting of multiple fields can be specified in a single frame, enqueuing field data up to the maximum length of the frame. Only the data part of every field is compressed.

GETZ (0x85)

The GETZ command (hexadecimal code 0x85) is intended for reading the content of the specified fields. The GETZ command has the same structure and semantic of command GET (0x81), as described in Figure 3. Using GETZ instead of GET will cause the device to answer with a DATZ frame instead of a DAT frame, having the DATZ frame compressed data.

So when the device receives a GETZ request, it simply reads the content of the field starting from the given offset, compress those data and builds a DATZ frame to be sent back to the requester.

ATTENTION: data offset are ALWAYS expressed referred to uncompressed data.

GETZ command is multi-field, that is the request for reading multiple fields can be specified in a single frame, enqueuing requests up to the maximum length of the frame.



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DATZ (0x86)

The DATZ command (hexadecimal code 0x86) is emitted by a device following to a GETZ request from the counterpart. The DATZ command has the same structure and semantic of command DAT (0x83), as described in Figure 5.

When the device receives a GETZ request, it simply reads the content of the field starting from the given offset, compress those data and builds a DATZ frame to be sent back to the requester.

ATTENTION: data offset are ALWAYS expressed referred to uncompressed data.

DATZ command is multi-field, that is information related to several fields can be specified in a single frame, enqueuing requests up to the maximum length of the frame. Only the data part of every field is compressed.

7 "Nice-start" and "Nice-end"

There are some cases in which the size of a field is intrinsically longer than the maximum length of a MEP frame, so that the field content can be entirely transferred only performing several subsequent exchanges between communication counterparts. This is typically the case of buffer fields or binary fields, in general.

For avoiding to write on device FLASH partial data (for both preserving the FLASH against multiple writings and having only valid data on FLASH) these fields are normally cached in the device RAM, until the communication counter part tells the device that the transfer is finished. Only at that moment the device actually writes received data to its storage location.

In other words, we say that the writing to some fields MUST be "nicely-ended", to inform the device that the data transfer has been completed and it can finalize it writing data to FLASH (once data have been written to FLASH, the temporary memory buffer is cleared).

To "nice-end" the writing of a field a final SET (or SETZ) primitive must be invoked on the device, passing to it the code of the field to be nice-ended, the total length of data as offset and a length equal to zero.

Field codes supporting "nice-ending" are marked with symbol ‡ in following tables.

Fields supporting "nice-ending" normally also supports "nice-starting". Since those fields are cached to memory before being written to FLASH, there is also mechanism to reset the temporary buffer resident in RAM. This is what we call "nice-start". To "nicely-start" writing to a field, simply invoke a SET (or SETZ) primitive on the device, passing to it the code of the field to be nice-started, offset zero, length zero. This will reset the temporary receive buffer.

Field codes supporting "nice-starting" are marked with symbol † in following tables.

8 Data types

This paragraph describes the structure of pre-defined data types; protocol implementers should pay particular attention to the definition of numeric fields.



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When handling numeric values, most significant bytes are always transferred (and listed) before least significant bytes. So, speaking about bit 0 of a multi-byte value, we always refer to the least significant bit of the least significant byte.

| Data type | Description | Length | Range of values | Notes |
|---|---|---|---|---|
| INT8 | Signed integer 8 bit | 1 | from -127 to +127 | The most significant bit (bit 7) represents the sign (0=positive number, 1 = negative number); bits 6 – 0 represents the module of the number (in standard binary notation); two distinct representation allowed for zero (+0 and -0) |
| UINT8 | Unsigned integer 8 bit | 1 | from 0 to 255 | Standard binary notation |
| INT16 | Signed integer 16 bit | 2 | from -32767 to +32767 | The most significant bit (bit 15) represents the sign (0=positive number, 1 = negative number); bits 15 – 0 represents the module of the number (in standard binary notation); two distinct representation allowed for zero (+0 and -0) |
| UINT16 | Unsigned integer 16 bit | 2 | from 0 to 65535 | Standard binary notation |
| INT32 | Signed integer 32 bit | 4 | from -2147483647 to +2147483647 | The most significant bit (bit 31) represents the sign (0=positive number, 1 = negative number); bits 30 – 0 represents the module of the number (in standard binary notation); two distinct representation allowed for zero (+0 and -0) |
| UINT32 | Unsigned integer 32 bit | 4 | from 0 to 4294967295 | Standard binary notation |
| BOOL | Boolean | 1 | 0 or non-zero | Logic False when 0, logic True when non-zero |
| BINARY | Binary data | variable | - | Generic binary data |



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| | | | | |
|---|---|---|---|---|
| STRING | Alphanumerical string | variable | - | Strings have not to be zero-terminated; bytes composing the string are interpreted using the standard UTF8 encoding |
| USTRING | Alphanumerical UNICODE string | variable | - | Strings have not to be zero-terminated; bytes composing the string are interpreted using the standard UTF16 (UNICODE) encoding |
| VOID | NULL type | 0 | - | Data type void is used for fields which does not contain data but represents functions entry-point |

Table 2: Predefined data types

9 Field definition

MEP definition comes with some built-in field codes (the most common ones in driving Aesys® devices).

The extensibility of the protocol is granted by the possibility given to each implementer to define his own field codes. Once defined, custom fields have to be considered as RESERVED, and cannot be re-defined by other implementers. It is also FORBIDDEN to change the size and type of an already defined field code. If such a need arises, then a new field code must be defined with new specifications (the previous code is kept for retrocompatibility).

Field codes are initially grouped by functionality, on the basis of directives depicted in Table 3.

| Code range | Group name | Description |
|---|---|---|
| 00000 – 00999 | Fundamentals | Firmware and device identification and basic operations |
| 01000 – 09999 | Function entry-points | Device function entry-points |
| 10000 – 19999 | Diagnostic sensors | Diagnostics information deriving from device on-board sensors |
| 20000 – 29999 | Device status | Device status information |
| 30000 – 39999 | Device settings | Device configuration data |
| 40000 – 59999 | Data | Application data |



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| | | |
|---|---|---|
| 60000 – 65535 | Reserved | Reserved for future usage |

Table 3: Field code groups

The following Table 4 gathers the list of pre-defined MEP built-in field codes. This list is aimed to grow as new implementers define their own field codes. It is responsibility of implementers to keep this list updated.

Please notice that Table 4 defines up to 10 different buffer types for hosting application data. Every buffer type implements at index XX998 a read-only field telling the code of the first available buffer within that type, while code XX999 returns a checksum of the actual content of the buffer type it refers to (XX999 can also be simply implemented as a counter: every time one of the buffers it refers to changes somehow the counter is incremented).

Codes XX999 can also be used for deleting the whole buffer type region they refers to. Deleting them resets them to their default value (depending on device FW) and deletes all fields XX000 to XX997 they refers to.

Buffer types from 0 to 4 are intended for alphanumerical buffers (~1000 slots), type from 5 to 9 are intended for pictograms/graphical buffers (~1000 slots). Buffer types from 10 to 14 are intended for general purpose applications (~100 slots each). However implementers may defined their own codes for specific buffers.

| Code | Name | Access | Field type | Length | Notes |
|---|---|---|---|---|---|
| 00000* | STATUS* | R | VOID | 0 | (cumulative answer) |
| 00001 | HARDWARE_MODEL | R | STRING | <= 16 | |
| 00002 | FIRMWARE_MODEL | R | STRING | <= 16 | |
| 00003 | FIRMWARE_VERSION | R | STRING | <= 16 | |
| 00004 | FIRMWARE_RELEASE | R | STRING | <= 16 | |
| 00010 | DEVICE_ID | R/W | STRING | <= 16 | |
| 00011 | DEVICE_DESCRIPTION | R/W | STRING | <= 64 | |
| 00100†‡ | FIRMWARE_UPGRADE_BUFFER†‡ | W | BINARY | variable | |
| 00101 | APPLY_FIRMWARE_AND_RESET | W | VOID | 0 | |



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| | | | | | |
|---|---|---|---|---|---|
| 00102 | RESET | W | VOID | 0 | |
| 00103 | SWITCH_OFF | W | VOID | 0 | |
| 00104 | SOLICIT_POLLING | W | VOID | 0 | |
| 00121 | ATTACHED_FIRMWARE_VERSION_1 | R/W | STRING | <= 64 | it is the version of the firmware actually running on the first attached device |
| 00122 | ATTACHED_FIRMWARE_VERSION_2 | R/W | STRING | <= 64 | |
| 00123 | ATTACHED_FIRMWARE_VERSION_3 | R/W | STRING | <= 64 | |
| 00124 | ATTACHED_FIRMWARE_VERSION_4 | R/W | STRING | <= 64 | |
| 00131†‡ | ATTACHED_FW_UPGRADE_1†‡ | W | BINARY | variable | this is a buffer used to upgrade the FW of the first attached device |
| 00132†‡ | ATTACHED_FW_UPGRADE_2†‡ | W | BINARY | variable | |
| 00133†‡ | ATTACHED_FW_UPGRADE_3†‡ | W | BINARY | variable | |
| 00134†‡ | ATTACHED_FW_UPGRADE_4†‡ | W | BINARY | variable | |
| 00141 | ATTACHED_FW_UPGRADE_VERSION_1 | R/W | STRING | <= 64 | this is the version of the FW available in the upgrade firmware buffer of the first attached device (code 00131) |
| 00142 | ATTACHED_FW_UPGRADE_VERSION_2 | R/W | STRING | <= 64 | |
| 00143 | ATTACHED_FW_UPGRADE_VERSION_3 | R/W | STRING | <= 64 | |
| 00144 | ATTACHED_FW_UPGRADE_VERSION_4 | R/W | STRING | <= 64 | |



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| | | | | | |
|---|---|---|---|---|---|
| 00151 | ATTACHED_FW_UPGRAGE_CKSUM_1 | R/W | UINT16 | 2 | this the CCITT-CRC16 checksum for the FW available in the upgrade firmware buffer of the first attached device<br>(code 00131) |
| 00152 | ATTACHED_FW_UPGRAGE_CKSUM_2 | R/W | UINT16 | 2 | |
| 00153 | ATTACHED_FW_UPGRAGE_CKSUM_3 | R/W | UINT16 | 2 | |

| | | | | | |
|---|---|---|---|---|---|
| 00154 | ATTACHED_FW_UPGRAGE_CKSUM_4 | R/W | UINT16 | 2 | |
| 00161 | ETHERNET_MAC_ADDRESS_1 | W | BINARY | 6 | BE CAREFUL: the MAC address is set only once at factory and *should* never be changed! |
| 00162 | ETHERNET_MAC_ADDRESS_2 | W | BINARY | 6 | BE CAREFUL: the MAC address is set only once at factory and *should* never be changed! |
| 01001 | VIS_ALPHA (VIA) | R/W | BINARY | variable | (see operation specs) |
| 01002 | VIS_GRAPH (VIG) | R/W | BINARY | variable | (see operation specs) |
| 01003 | VIS_IMMEDIATE_ALPHAGRAPH (VII) | R/W | BINARY | variable | (see operation specs) |
| 01004 | VIS_MIXED_ALPHAGRAPH (VIM) | R/W | BINARY | variable | (see operation specs) |
| 01005 | VIS_CODES_ALPHAGRAPH (VIC) | R/W | BINARY | variable | (see operation specs) |
| 01006†‡ | VIS_EXTENSIBLE†‡ | R/W | BINARY | variable | (see operation specs) |
| 01101 | VIS_HTML_PAGES | R/W | BINARY | variable | (see operation specs) |



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| 01102†‡ | HTML_DATA†‡ | W | BINARY | variable | (see operation specs) |
|---|---|---|---|---|---|
| 10001 | TEMP_1 | R | INT8 | 1 | |
| 10002 | TEMP_2 | R | INT8 | 1 | |
| 10003 | TEMP_3 | R | INT8 | 1 | |
| 10004 | TEMP_4 | R | INT8 | 1 | |
| 10005 | TEMP_5 | R | INT8 | 1 | |
| 10006 | TEMP_6 | R | INT8 | 1 | |
| 10007 | TEMP_7 | R | INT8 | 1 | |
| 10008 | TEMP_8 | R | INT8 | 1 | |
| 10101 | HUMIDITY_1 | R | UINT8 | 1 | |
| 10102 | HUMIDITY_2 | R | UINT8 | 1 | |
| 10103 | HUMIDITY_3 | R | UINT8 | 1 | |
| 10104 | HUMIDITY_4 | R | UINT8 | 1 | |
| 10201 | ENVIRONMENTAL_BRIGHTNESS_1 | R | UINT8 | 1 | |
| 10202 | ENVIRONMENTAL_BRIGHTNESS_2 | R | UINT8 | 1 | |
| 10203 | ENVIRONMENTAL_BRIGHTNESS_3 | R | UINT8 | 1 | |
| 10204 | ENVIRONMENTAL_BRIGHTNESS_4 | R | UINT8 | 1 | |
| 10301 | POWER_SUPPLY_ONOFF_1 | R | BOOL | 1 | |
| 10302 | POWER_SUPPLY_ONOFF_2 | R | BOOL | 1 | |
| 10303 | POWER_SUPPLY_ONOFF_3 | R | BOOL | 1 | |
| 10304 | POWER_SUPPLY_ONOFF_4 | R | BOOL | 1 | |
| 10305 | POWER_SUPPLY_ONOFF_5 | R | BOOL | 1 | |
| 10306 | POWER_SUPPLY_ONOFF_6 | R | BOOL | 1 | |



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| | | | | | |
|---|---|---|---|---|---|
| 10307 | POWER_SUPPLY_ONOFF_7 | R | BOOL | 1 | |
| 10308 | POWER_SUPPLY_ONOFF_8 | R | BOOL | 1 | |
| 10309 | POWER_SUPPLY_ONOFF_9 | R | BOOL | 1 | |
| 10310 | POWER_SUPPLY_ONOFF_10 | R | BOOL | 1 | |
| 10311 | POWER_SUPPLY_ONOFF_11 | R | BOOL | 1 | |
| 10312 | POWER_SUPPLY_ONOFF_12 | R | BOOL | 1 | |
| 10313 | POWER_SUPPLY_ONOFF_13 | R | BOOL | 1 | |
| 10314 | POWER_SUPPLY_ONOFF_14 | R | BOOL | 1 | |
| 10315 | POWER_SUPPLY_ONOFF_15 | R | BOOL | 1 | |
| 10316 | POWER_SUPPLY_ONOFF_16 | R | BOOL | 1 | |
| 10401 | POWER_SUPPLY_VOLTAGE_1 | R | UINT16 | 2 | |
| 10402 | POWER_SUPPLY_VOLTAGE_2 | R | UINT16 | 2 | |
| 10403 | POWER_SUPPLY_VOLTAGE_3 | R | UINT16 | 2 | |
| 10404 | POWER_SUPPLY_VOLTAGE_4 | R | UINT16 | 2 | |
| 10405 | POWER_SUPPLY_VOLTAGE_5 | R | UINT16 | 2 | |
| 10406 | POWER_SUPPLY_VOLTAGE_6 | R | UINT16 | 2 | |
| 10407 | POWER_SUPPLY_VOLTAGE_7 | R | UINT16 | 2 | |

| | | | | | |
|---|---|---|---|---|---|
| 10408 | POWER_SUPPLY_VOLTAGE_8 | R | UINT16 | 2 | |
| 10409 | POWER_SUPPLY_VOLTAGE_9 | R | UINT16 | 2 | |
| 10410 | POWER_SUPPLY_VOLTAGE_10 | R | UINT16 | 2 | |
| 10411 | POWER_SUPPLY_VOLTAGE_11 | R | UINT16 | 2 | |
| 10412 | POWER_SUPPLY_VOLTAGE_12 | R | UINT16 | 2 | |



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| | | | | | |
|---|---|---|---|---|---|
| 10413 | POWER_SUPPLY_VOLTAGE_13 | R | UINT16 | 2 | |
| 10414 | POWER_SUPPLY_VOLTAGE_14 | R | UINT16 | 2 | |
| 10415 | POWER_SUPPLY_VOLTAGE_15 | R | UINT16 | 2 | |
| 10416 | POWER_SUPPLY_VOLTAGE_16 | R | UINT16 | 2 | |
| 10501 | BATTERY_VOLTAGE_1 | R | UINT16 | 2 | |
| 10502 | BATTERY_VOLTAGE_2 | R | UINT16 | 2 | |
| 10503 | BATTERY_VOLTAGE_3 | R | UINT16 | 2 | |
| 10504 | BATTERY_VOLTAGE_4 | R | UINT16 | 2 | |
| 10600 | GPS_UPDATE_TIMESTAMP | R | BINARY | 6 | ymdhms (y = year – 2000) |
| 10601 | GPS_LATITUDE | R/W | INT32 | 4 | Specified in Aesys™<br>Format (that is WGS84 UTM32 format multiplied by 60000 and rounded to the nearest integer) |
| 10602 | GPS_LONGITUDE | R/W | INT32 | 4 | Specified in Aesys™<br>Format (that is WGS84 UTM32 format multiplied by 60000 and rounded to the nearest integer) |
| 20001 | DIP_SWITCH_1 | R | UINT8 | 1 | |
| 20002 | DIP_SWITCH_2 | R | UINT8 | 1 | |
| 20003 | DIP_SWITCH_3 | R | UINT8 | 1 | |
| 20004 | DIP_SWITCH_4 | R | UINT8 | 1 | |
| 20005 | DIP_SWITCH_5 | R | UINT8 | 1 | |
| 20006 | DIP_SWITCH_6 | R | UINT8 | 1 | |



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| | | | | | |
|---|---|---|---|---|---|
| 20007 | DIP_SWITCH_7 | R | UINT8 | 1 | |
| 20008 | DIP_SWITCH_8 | R | UINT8 | 1 | |
| 21000 | CABINET_DOOR_OPEN | R/W | UINT8 | 1 | 0/1; the meaning depends on the device implementation |
| 21001 | DEVICE_RESTARTED | R | BOOL | 1 | |
| 21002 | DOORS_OPEN | R | BOOL | 1 | |
| 21003 | EEPROM_RAM_ERROR | R | BOOL | 1 | |
| 21004 | UNSTEADY_DIAGNOSTIC | R | BOOL | 1 | |
| 21005 | DIAGNOSTIC_CHAIN_ERROR | R | BOOL | 1 | |
| 21006 | SERVICE_PC_CONNECTED | R | BOOL | 1 | |
| 21007 | SOCKET_ERRORS_NUMBER | R | UINT16 | 2 | |
| 21008 | WATCHDOG_RESETS_NUMBER | R | UINT16 | 2 | |
| 21009 | COMM_TX | R | UINT32 | 4 | Total bytes transmitted from power-up |
| 21010 | COMM_RX | R | UINT32 | 4 | Total bytes received from power-up |
| 21011 | COMM_SESSION_TX | R | UINT32 | 4 | Bytes transmitted by the device during the active client connection |
| 21012 | COMM_SESSION_RX | R | UINT32 | 4 | Bytes received by the device during the active client connection |
| 21020 | POWER_SAVING_STATUS | R | UINT8 | 1 | The power saving level: 0 = No power saving (AC connected) |



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| | | | | | |
|---|---|---|---|---|---|
| | | | | | 1 = No power saving<br>(running on batteries)<br>2 = Power saving level 1<br>3 = Power saving level 2<br>… |
| 21021 | BATTERY_LEVEL | R/W | UINT8 | 1 | 0/1; the meaning depends on the device implementation |
| 21022 | AC_CONNECTED | R/W | UINT8 | 1 | 0/1; the meaning depends on the device implementation |
| 21030 | FUEL_LEVEL | R/W | UINT8 | 1 | 0/1; the meaning depends on the device implementation |
| 21050 | PUBLICATION_STATUS | R | UINT8 | 1 | 0 = publication active<br>1 = blank due to restart<br>2 = blank due to timeout<br>3 = blank due to request<br>4 = driven by digital I/O 5 = driven by local console |
| 22001 | FANS_ACTIVE | R | BOOL | 1 | |
| 22002 | HEATING_ACTIVE | R | BOOL | 1 | |
| 22003 | SIREN_ACTIVE | R | BOOL | 1 | |



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| | | | | | |
|---|---|---|---|---|---|
| 23001 | BROKEN_FANS_NUMBER | R | UINT8 | 1 | |
| 23002 | BROKEN_DRIVERS_NUMBER | R | UINT32 | 4 | |
| 23003 | BROKEN_LEDS_NUMBER | R | UINT32 | 4 | |
| 23004 | BROKEN_LEDS_MAP | R | BINARY | variable | |
| 23005 | BROKEN_BACKLIGHTS_NUMBER | R | UINT8 | 1 | |
| 23051 | ANTI_TAMPERING_ALERT_1 | R | BOOL | 1 | If TRUE the antitampering device is harmed |
| 23052 | ANTI_TAMPERING_ALERT_2 | R | BOOL | 1 | If TRUE the antitampering device is harmed |
| 23053 | ANTI_TAMPERING_ALERT_3 | R | BOOL | 1 | If TRUE the antitampering device is harmed |
| 23054 | ANTI_TAMPERING_ALERT_4 | R | BOOL | 1 | If TRUE the antitampering device is harmed |
| 24001 | GPRS_CONNECTION_STATUS | R | UINT8 | 1 | Status of the GPRS connection 0 = modem not initialized<br>1 = waiting for network<br>2 = waiting for end-point<br>3 = connected |
| 24020 | GSM_CONNECTION_STATUS | R | UINT8 | 1 | Status of the GSM connection 0 = modem not initialized |



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| | | | | | |
|---|---|---|---|---|---|
| | | | | | 1 = waiting for network<br>2 = not connected<br>3 = connected |
| 24021 | GSM_SIGNAL_QUALITY | R | UINT8 | 1 | GSM signal quality (range 0 – 100, 0=worst quality, 100=best quality) |
| 30001 | CLOCK | R/W | BINARY | 6 | ymdhms (y = year – 2000) |
| 31001 | FANS_FORCED | R/W | BOOL | 1 | |
| 31002 | HEATING_FORCED | R/W | BOOL | 1 | |
| 31003 | SIREN_FORCED | R/W | BOOL | 1 | |
| 31004 | SIREN_ALARM_DURATION_SECS | R/W | UINT8 | 1 | This is the period of time the siren keeps running when an alarm is detected (0=disable siren) |
| 31005 | SIREN_PREALARM_DURATION_SECS | R/W | UINT8 | 1 | This is the period of time that elapses between the alarm detection and the siren activation |
| 32001 | BRIGHTNESS_1 | R/W | UINT8 | 1 | |
| 32002 | BRIGHTNESS_2 | R/W | UINT8 | 1 | |
| 32003 | BRIGHTNESS_3 | R/W | UINT8 | 1 | |
| 32004 | BRIGHTNESS_4 | R/W | UINT8 | 1 | |
| 33001 | VISUALIZATION_TIMEOUT_SECS_1 | R/W | UINT16 | 2 | |



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| | | | | | |
|---|---|---|---|---|---|
| 33002 | VISUALIZATION_TIMEOUT_SECS_2 | R/W | UINT16 | 2 | |
| 33003 | VISUALIZATION_TIMEOUT_SECS_3 | R/W | UINT16 | 2 | |
| 33004 | VISUALIZATION_TIMEOUT_SECS_4 | R/W | UINT16 | 2 | |
| 33010 | FORCE_AC_CONNECTED | R/W | BOOL | 1 | If TRUE the device is forced to consider its status as connected to the AC power supply |
| 33011 | POWER_SAVING_BEHAVIOUR | R/W | UINT8 | 1 | 0 = none (ignore power saving status)<br>1 = save by time (LED flashes in order to save power)<br>2 = save by light (LED brightness is reduced to<br>save power) |
| 33020 | CONTROL_MODE | R/W | UINT8 | 1 | 0 = Control by remote 1 = Control by local console |
| 33050 | REMEMBER_LAST_PUBLICATION | R/W | BOOL | 1 | If TRUE the device on boot will automatically shown the last publication, otherwise it will show the default page |
| 33100 | TRAFFIC_LIGHT_STATUS_1 | R/W | BINARY | 2 | byte 0: bit 0 = red lamp bit 1 = orange lamp bit 2 = green lamp byte 1: bit 0 = red flashing bit 1 = orange flashing bit 2 = green flashing |
| 33101 | TRAFFIC_LIGHT_STATUS_2 | R/W | BINARY | 2 | (see above) |



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| | | | | | |
|---|---|---|---|---|---|
| 33102 | TRAFFIC_LIGHT_STATUS_3 | R/W | BINARY | 2 | (see above) |
| 33103 | TRAFFIC_LIGHT_STATUS_4 | R/W | BINARY | 2 | (see above) |
| 35001 | GPRS_STATUS_POLLING_MINS | R/W | UINT8 | 1 | |
| 35002 | GPRS_CONNECTION_TIMEOUT_MINS | R/W | UINT8 | 1 | If this timeout elapses the modem is re- |
| | | | | | initialized; 0 to disable this feature |
| 35003 | GPRS_CONNECTION_MODE | R/W | UINT8 | 1 | 0 = connect, 1 = listen |
| 35004 | GPRS_CONNECTION_IP_ADDRESS | R/W | BINARY | 4 | In format A.B.C.D, byte A is listed first |
| 35005 | GPRS_CONNECTION_TCP_PORT | R/W | UINT16 | 2 | |
| 35006 | GPRS_CONNECTION_APN | R/W | STRING | <= 32 | |
| 35007 | GPRS_CONNECTION_ID | R/W | STRING | <= 32 | Leave blank for public APN |
| 35008 | GPRS_CONNECTION_PASSWORD | R/W | STRING | <= 32 | Leave blank for public APN |
| 35009 | GPRS_AUTHENTICATION_MODE | R/W | UINT8 | 1 | Allowed values:<br>0 = CHAP<br>1 = PAP |
| 35020 | GSM_CONNECTION_TIMEOUT_MINS | R/W | UINT8 | 1 | If this timeout elapses the modem is reinitialized; 0 to disable this feature |
| 35021 | GSM_CONNECTION_PHONE_NUMBER | R/W | STRING | <= 32 | It is the phone number to<br>call to contact the server machine using GSM |



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| | | | | | |
|---|---|---|---|---|---|
| 35022 | GSM_MODEM_INITSTRING | R/W | STRING | <= 64 | It is the initialization string to be used with the GSM modem (AT commands separated by pipes) |
| 40000†‡ | BUFFER_TYPE0_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 40997†‡ | BUFFER_TYPE0_997†‡ | R/W | BINARY | variable | |
| 40998 | BUFFER_TYPE0_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 40999 | BUFFER_TYPE0_LEVEL | R/W | UINT32 | 4 | progressive or checksum |
| … | … | … | … | … | |
| 41000†‡ | BUFFER_TYPE1_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 41997†‡ | BUFFER_TYPE1_997†‡ | R/W | BINARY | variable | |
| 41998 | BUFFER_TYPE1_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 41999 | BUFFER_TYPE1_LEVEL | R/W | UINT32 | 4 | progressive or checksum |
| … | … | … | … | … | |
| … | … | … | … | … | |
| 49000†‡ | BUFFER_TYPE9_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 49997†‡ | BUFFER_TYPE9_997†‡ | R/W | BINARY | variable | |
| 49998 | BUFFER_TYPE9_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 49999 | BUFFER_TYPE9_LEVEL | R/W | UINT32 | 4 | progressive or checksum |



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| | | | | | |
|---|---|---|---|---|---|
| 50000†‡ | BUFFER_TYPE10_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 50097†‡ | BUFFER_TYPE10_97†‡ | R/W | BINARY | variable | |
| 50098 | BUFFER_TYPE10_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 50099 | BUFFER_TYPE10_LEVEL | R/W | UINT32 | 4 | progressive or checksum |
| 50100†‡ | BUFFER_TYPE11_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 50197†‡ | BUFFER_TYPE11_97†‡ | R/W | BINARY | variable | |
| 50198 | BUFFER_TYPE11_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 50199 | BUFFER_TYPE11_LEVEL | R/W | UINT32 | 4 | progressive or checksum |
| 50200†‡ | BUFFER_TYPE12_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 50297†‡ | BUFFER_TYPE12_97†‡ | R/W | BINARY | variable | |
| 50298 | BUFFER_TYPE12_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 50299 | BUFFER_TYPE12_LEVEL | R/W | UINT32 | 4 | progressive or checksum |
| 50300†‡ | BUFFER_TYPE13_0†‡ | R/W | BINARY | variable | |
| … | … | … | … | … | |
| 50397†‡ | BUFFER_TYPE13_97†‡ | R/W | BINARY | variable | |
| 50398 | BUFFER_TYPE13_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 50399 | BUFFER_TYPE13_LEVEL | R/W | UINT32 | 4 | progressive or checksum |
| 50400†‡ | BUFFER_TYPE14_0†‡ | R/W | BINARY | variable | |



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| | | | | | |
|---|---|---|---|---|---|
| … | … | … | … | … | |
| 50497†‡ | BUFFER_TYPE14_97†‡ | R/W | BINARY | variable | |
| 50498 | BUFFER_TYPE14_FIRSTAVAILABLE | R | UINT16 | 2 | |
| 50499 | BUFFER_TYPE14_LEVEL | R/W | UINT32 | 4 | progressive or checksum |

Table 4: Pre-defined built-in MEP field codes

## 10 Operations definition

This paragraph describes the structure of pre-defined operations, how to start them and which are their input/output parameters.

APPLY_FIRMWARE_AND_RESET (00101)

The operation is started writing any value (of any length) to the field coded 00101 (no input parameters are needed, so whatever value you set to field 00101 will be discarded).

The binary stream of the firmware to be upgraded MUST be written to field 00100 before writing to field 00101.

Device performing an APPLY_FIRMWARE_AND_RESET must respond with a DAT frame in any case (if the firmware upgrade was successful it must respond before proceeding to reset). No return values are defined. The device can communicate that the operation was not successful simply setting the error code 3 (cannot read/write) within flags field of the DAT frame emitted as response.

Since field 00100 supports nice-ending another way to cause the firmware application and reset is to simply send the "nice-end" command on field 00100.

VIS_ALPHA (01001)

This command is similar to VIA command available in Aesys® former PMV 1.2.0 / PMV 1.3.0 protocols. The operation is started writing the following data structure to field 01001.

| Input parameters | |
|---|---|
| bytes 0 – n | Alphanumerical buffer (as specified for PMV 1.2.0 / PMV 1.3.0 protocols) |



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No return values are defined for this operation. The device can communicate that the operation was not successful simply setting the error code 3 (cannot read/write) within flags field of the DAT frame emitted as response.

VIS_GRAPH (01002)

This command is similar to VIG command available in Aesys® former PMV 1.2.0 / PMV 1.3.0 protocols. The operation is started writing the following data structure to field 01002.

| Input parameters | |
|---|---|
| bytes 0 – n | Graphical buffer (as specified for PMV 1.2.0 / PMV 1.3.0 protocols) |

No return values are defined for this operation. The device can communicate that the operation was not successful simply setting the error code 3 (cannot read/write) within flags field of the DAT frame emitted as response.

VIS_IMMEDIATE_ALPHAGRAPH (01003) (to-be-completed)

VIS_MIXED_ALPHAGRAPH (01004) (to-be-completed)

VIS_CODES_ALPHAGRAPH (01005)

(to-be-completed)

VIS_EXTENSIBLE (01006)

This command aims to replace all previous VII/VIA/VIG/VIC commands available in former Aesys® protocols. The operation is started writing the following data structure to field 01006.

| Input parameters | | |
|---|---|---|
| Number of elements (NOE) | 1 byte | The number of elements (that is "visualization parts") to be set with this command (NOE = 0 to blank the visualization) |
| Elements list | variable | (see below) |

Here follows the definition of "Elements list".

| Elements list |
|---|



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| | | |
|---|---|---|
| Element ID | 1 byte | The ID of the element to be set with this structure (the ID of the elements depends on the FW); from the software point of view this is the position in which the corresponding module is defined in the Aesys® panel layout |
| Element data | variable | (see below) |

Here follows the definition of "Element data".

| Element data | | |
|---|---|---|
| Number of pages (NOP) | 1 byte | The number of pages to be set for the current element with this structure (NOP = 0 to blank the visualization of the element) |
| Page data | variable | (see below) |

Here follows the definition of "Page data".

| Page data | | |
|---|---|---|
| Duration (seconds) | 1 byte | 1 – 255 (setting the duration to zero the page will be ignored) |
| Page parameters | 1 byte | bit 0: enable flashing lamps bit 1 – 7: not used |
| Page type | 1 byte | 0 = page specified by buffer 1 = page specified by code |
| Page length | 2 bytes | The length of the subsequent "page definition" field (in bytes); if the page is specified by code |
| | | then the page length is ignored (since the following field will always be 2 byte long); please refer to paragraph "Drawing commands" for further info about the content of this field<br>when the page is specified by buffer |



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| | | |
|---|---|---|
| Page definition | 2/variable | The buffer defining the page or the code (UINT16) of the page |

No return values are defined for this operation. The device can communicate that the operation was not successful simply setting the error code 3 (cannot read/write) within flags field of the DAT frame emitted as response.

VIS_HTML_PAGES (01101)

This command starts the publication on the device of the HTML pages previously uploaded within buffers (type 10).

The operation is started writing a proper data structure to field 01101 (see the following table for details).

| Input parameters | |
|---|---|
| bytes 0 – 1 | Number of pages (up to 64) |
| byte 2 | Buffer index of page 1 |
| byte 3 | Duration of page 1 (in seconds) |
| byte 4 | Buffer index of page 2 |
| byte 5 | Duration of page 2 (in seconds) |
| … | … |
| byte 2*n | Buffer index of page “n” |
| byte 2*n + 1 | Duration of page “n” (in seconds) |

Buffer index entries should be intended referred to buffers type 10 (so if the third byte of input parameters is set to 15 it means that the code of the HTML page to be shown as first page is contained into the field 50015 (BUFFER_TYPE10_15).

| Output parameters |
|---|



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| | |
|---|---|
| byte 0 | Operation exit status<br>0: success<br>1: some pages do not exist<br>2: cannot show some pages (HTML code not valid?) |

HTML_DATA (01102)

Data (animations, bitmaps) to be used in HTML pages shown by previous command VIS_HTML_DATA (01101) can be uploaded to the device writing to field 01102 (HTML_DATA). HTML data are normally stored to the device FLASH disk within the same directory used for hosting HTML pages, so they can be referred from HTML starting from the page directory.

HTML_DATA field allows to write new data to FLASH memory (if data with the same filename already exist, they will be overwritten). To fully erase the content of the data FLASH memory in order to upload completely new data, it is requested to perform a DELETE on the field 01102 prior to new data upload.

The following table show the format to be used for data uploading.

| Field name | Field length | Description |
|---|---|---|
| fileName | 32 | The file name to be used for writing to FLASH disk |
| fileLength | 4 | The length (in bytes) of the file to be written |
| fileData | (variable) | The content of the file |
| fileName | 32 | The file name to be used for writing to FLASH disk |
| fileLength | 4 | The length (in bytes) of the file to be written |
| fileData | (variable) | The content of the file |
| … | … | … |

HTML data are initially transferred to a temporary memory location, before being written on FLASH; to finalize the transfer and actually write data onto FLASH, the operation must be



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completed sending a SET command having zero length and offset equal to the length of data already transferred. So, if for example, HTML data are 169899 byte long, to finalize the operation it is required to send a SET request having offset 169899 and length equal to zero (nice-ending).

If the writing operation does not return any error then the operation was successful, otherwise some troubles has occurred (typically the FLASH cannot be written for some reason [full disk for example]).

BROKEN_LEDS_MAP (23004)

Getting the BROKEN_LEDS_MAP fields gives back the map of LEDs that are not currently working. The map is represented by the following data structures (mimicking the structure used for VIS_EXTENSIBLE command):

| Input parameters | | |
|---|---|---|
| Number of elements (NOE) | 1 byte | The number of elements (that is "visualization parts") whose broken LEDs map is returned with this command (NOE = 0 for an empty map) |
| Elements list | variable | (see below) |

Here follows the definition of "Elements list".

| Elements list | | |
|---|---|---|
| Element ID | 1 byte | The ID of the element returned with this structure (the ID of the elements depends on the FW); from the software point of view this is the position in which the corresponding module is defined in the Aesys® panel layout |
| Element data | variable | (see below) |

Here follows the definition of "Element data".

| Element data | | |
|---|---|---|
| Map type | 1 byte | The encoding of the broken LEDs map; possible values are:<br>0: Aesys® alphanumerical format |



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| | | |
|---|---|---|
| | | 1: Aesys® graphical format<br>2: Aesys® arrow/cross format |
| Map length | 2 bytes | The length of the subsequent "map definition" field (in bytes) |
| Map definition | 2/variable | The byte stream defining the map (formatted accordingly with the type previously specified) |

The map of broken LEDs can be specified in alphanumerical or graphical, depending on the VMS type. The format of the map can be discerned looking at the actual value of the field "Map type" returned by the VMS itself.

Following paragraph described both the map formats.

Broken LEDs map alphanumerical format

Letterblock VMSs use the alphanumerical format for specifying the broken LEDs map.

Broken LEDs map contains the status of each LED (or group of LEDs) that can be checked by diagnostics.

The size of the map depends on the sign size and characteristics, so please refer to the specific Aesys® VMS documentation to know the correct length of this field.

Let's suppose to use a 3 rows by 18 columns sign with 3 groups (chains) of LEDs for each dot. Let's also assume that every letter composing the letter block VMS is represented using a 7x5 font.

In such a scenario, the number of dots representing a letter is 7x5 + 5 = 40 (in 7x5 letters a line of LED is not mounted), while the number of LED chains representing a letter is 40 x 3 = 120. The complete sign then consists of 120 x 3 x 18 = 6480 LED chains.

Being the status of every LED chain representable by a single bit (0 = not working, 1 = working), then the full VMS broken LEDs map in alphanumerical format takes 6480 / 8 = 810 bytes.

The map representation order is provided by following schemas.

| | C1 | | | C2 | | | C3 | | | C4 | | | C5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R1 | 15th | 14th | 13th | 12th | 11th | 10th | 9th | 8th | 7th | 6th | 5th | 4th | 3rd | 2nd | 1st |
| R2 | | | | | | | | | | | | | | | |



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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R3** | | | | | | | | | | | | | | | |
| **R4** | | | | | | | | | | | | | | | |
| **R5** | | | | | | | | | | | | | | | |
| **R6** | | | | | | | | | | | | | | | |
| **R7** | | | | | | | | | | | | | | | |
| **R8** | | | | | | | | | | | | | | | |

*VMS front view; each cell represents a diagnostics byte*

*(R1, that is the dot not shown, is the most significant bit)*

VMS letters are mapped from the top-right corner of the VMS proceeding left and down to the bottom-left corner.

| | **C1** | **C2** | | **C17** | **C18** |
|---|---|---|---|---|---|
| **R1 (8 pixels)** | 18th | 17th | | 2nd | 1st |
| **R2 (8 pixels)** | 36th | 35th | | 20th | 19th |
| **R3 (8 pixels)** | 54th | 53rd | | 38th | 37th |

*VMS front view; each cell is a VMS letter*

Broken LEDs map graphical format

Non-letterblock VMSs use the graphical format for specifying the broken LEDs map.

Broken LEDs map contains the status of each LED (or group of LEDs) that can be checked by diagnostics.

The size of the map depends on the sign size and characteristics, so please refer to the specific Aesys® VMS documentation to know the correct length of this field.

Signs are composed by 16x8 (width x height) modular LED boards.



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Let's suppose to use a 48x48 sign with 4 colours per pixel (RGBY – red, green, blue and yellow) and so 4 LEDs for each dot. Every LED can be checked, so the total number of bits for representing the broken LEDs map is 48 x 48 x 4 = 9216 bits, that is 9216 / 8 = 1125.

Each diagnostics byte inside a single dots column follows the next order:

| | Red | Green | Blue | Yellow |
|---|---|---|---|---|
| R1 | | | | |
| R2 | | | | |
| R3 | | | | |
| R4 | 1st | 2nd | 3rd | 4th |
| R5 | | | | |
| R6 | | | | |
| R7 | | | | |
| R8 | | | | |

*Front view; each cell represents a diagnostics byte; R1 is the most significant bit*

Dots columns are mapped to LED boards as specified by following schema:

| | DC1 | DC2 | | DC15 | DC16 |
|---|---|---|---|---|---|
| R1 | | | | | |
| R2 | | | | | |
| R3 | | | | | |
| R4 | 16th | 15th | | 2nd | 1st |
| R5 | | | | | |
| R6 | | | | | |
| R7 | | | | | |



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| | | | | | |
|---|---|---|---|---|---|
| **R8** | | | | | |

*Front view; each cell represents a dots column*

LED boards are mapped from the top-left corner of the VMS proceeding right and down to the bottom-right corner.

| | **BC1** | **BC2** | **BC3** |
|---|---|---|---|
| **BR1** | 1st | 2nd | 3rd |
| **BR2** | 4th | 5th | 6th |
| **BR3** | 7th | 8th | 9th |
| **BR4** | 10th | 11th | 12th |
| **BR5** | 13th | 14th | 15th |
| **BR6** | 16st | 17nd | 18rd |

*Front view; each cell represents a LEDs board*

Broken LEDs map arrow/cross format

Arrow/cross modules use the arrow/cross format for specifying the broken LEDs map. Broken LEDs map contains the status of each LED (or group of LEDs) that can be checked by diagnostics.

The size of broken LEDs map specified in arrow/cross format is always 64 x 3 = 192 bytes long, even if not all the bytes are relevant.

Actually, the broken LEDs map is composed by 3 rows of 64 bytes each. Each row represents a specific LED color, and colors are listed using the following order: yellow, green, red. The structure of every row differs depending on color it refers to, as represented by the following schema.

| **Row** | **Color** | **Description** | |
|---|---|---|---|
| | | ***Byte positions*** | ***Board index*** |



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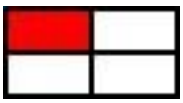
| | | | |
|---|---|---|---|
| **1** | Yellow | 1st – 11th | 4 |
| | | 12th – 22nd | 3 |
| | | 23rd – 34th | 2 |
| | | 35th – 45th | 1 |
| | | 46th – 64th | (not-used) |
| **2** | Green | 1st – 4th | 4 |
| | | 5th – 8th | 3 |
| | | 9th – 12th | 2 |
| | | 13th – 16th | 1 |
| | | 17th – 64th | (not-used) |
| **3** | Red | 1st – 3rd | 4 |
| | | 4th – 6th | 3 |
| | | 7th – 9th | 2 |
| | | 9th – 12th | 1 |
| | | 13th – 64th | (not-used) |

The board index reported in the previous table refers to the actual position of LED boards composing the VMS, accordingly with following schema:

| **Board index** | **Board position (VMS front view)** |
|---|---|
| 1 |  |



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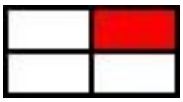
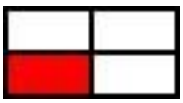
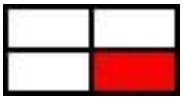
| | |
|---|---|
| 2 |  |
| 3 |  |
| 4 |  |

Every bit of a significant byte of a row represents the status of a specific LED (0 = not working, 1 = working). Due to the VMS structure it is not easy to determine with LED exactly corresponds to which bit (and even it is not so useful on such VMSs).

### 11 Drawing commands

When a message page is specified by buffer, then it means that the publication requested must provide to the VMS the set of commands for drawing the page on the VMS itself. The set of commands to be interpreted by the VMS in order to render the desired page is called "buffer".

Depending on the VMS type, the buffer can be specified in alphanumerical format or in graphical format. Please refer to Aesys® VMS documentation in order to determine which is the correct format to be used.

### 12 Alphanumerical format

The buffer basically contains the text to be published in the page, but also some formatting commands are allowed. The following table gathers and explains all these commands.

Symbol <17> represents the character having hexadecimal ASCII code equal to 17 (23 decimal). This character is usually called ETB (end-of-transmission-block).

| Sequence | Function |
|---|---|
| @@@DATA@@@ | Shows the current date as held by the VMS (dd/MM/yyyy format) |
| @@DATA@@ | Shows the current date as held by the VMS (dd/MM/yy format) |
| @ORA@ | Shows the current time as held by the VMS (hh:mm format) |



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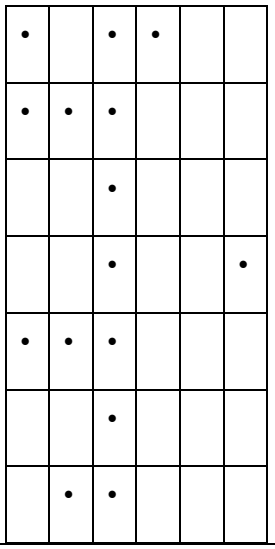
| | |
|---|---|
| <17>Qyyyxxx | Move the cursor to given coordinates $_{yyy}$ (vertical position) and $_{xxx}$ (horizontal position); $_{xxx}$ and $_{yyy}$ are expressed as hexadecimal values and must be 3 character long yyy = "000" – "FFF" [default = 0] xxx = "000" – "FFF" [default = 0] |
| <17>Fncr | Start using font $_{n}$ setting inter-column spacing ($_{c}$ pixels) and inter-row spacing ($_{r}$ pixels) n = "0" – "4" [default = 0] c = "0" – "9" [default = 2] r = "0" – "9" [default = 3] |
| <17>SHv | Starts horizontal scrolling setting the scrolling speed ($_{v}$ is the scrolling speed) v = "0" (non-scrolling), "1" (slow) – "9" (fast) [default = 0] |
| <17>Cc | Set the color $_{c}$ (only for multi-color VMSs)<br>c = "0" for red, "1" for green, "2" for blue, "3" for yellow and "4" for white [default = 4] |
| <17>O | Toggle compact font [by default font is not compact] |
| <17>A | Toggle blinking text |
| <17>G | Toggle graphical area.<br><br>Graphical data must be sent as hexadecimal values always over two characters ("00" – "FF"). Each data (byte) represents a column of 8 pixels where the topmost pixel is the most significant bit.<br><br>Example:<br>To publish the following graphic...<br><br>  |



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| | |
|---|---|
| | • • •<br>...the following buffer must be sent:<br><17>GC94AFF800011<17>G |

The encoding to be used for text publication basically reflects ISO-8859-1, but may also depend on specific fonts available on-board the VMS. Please refer to Aesys® VMS documentation for further details about text enconding.

### 13 Graphical format

The buffer contains the picture to be shown encoded in Aesys® PIT format.

Usually PIT files are provided by Aesys® and can be created by a specific software which generates them starting from BMP files.

Important: if a picture has to be shown, the length of the buffer must exactly match the size of the module it has to be published to. So, for example, when using a 48x48 sign with 3 colours (RGB) per pixel and 4 bits per colour, the PIT file size results equal to 27648 bits (48x48x3x4), hence the buffer length must be equal to 3456 bytes (27648/8).

Specifying a wrong-length buffer may result in a wrong-syntax error from the VMS (in such a casa the incorrect buffer will not be published at all).

The sign is blanked simply specifying a null buffer (that is a buffer 0 byte long).

### 14 Usage examples

This paragraph gathers some usage example of the ME protocol. Every figure is separately described.



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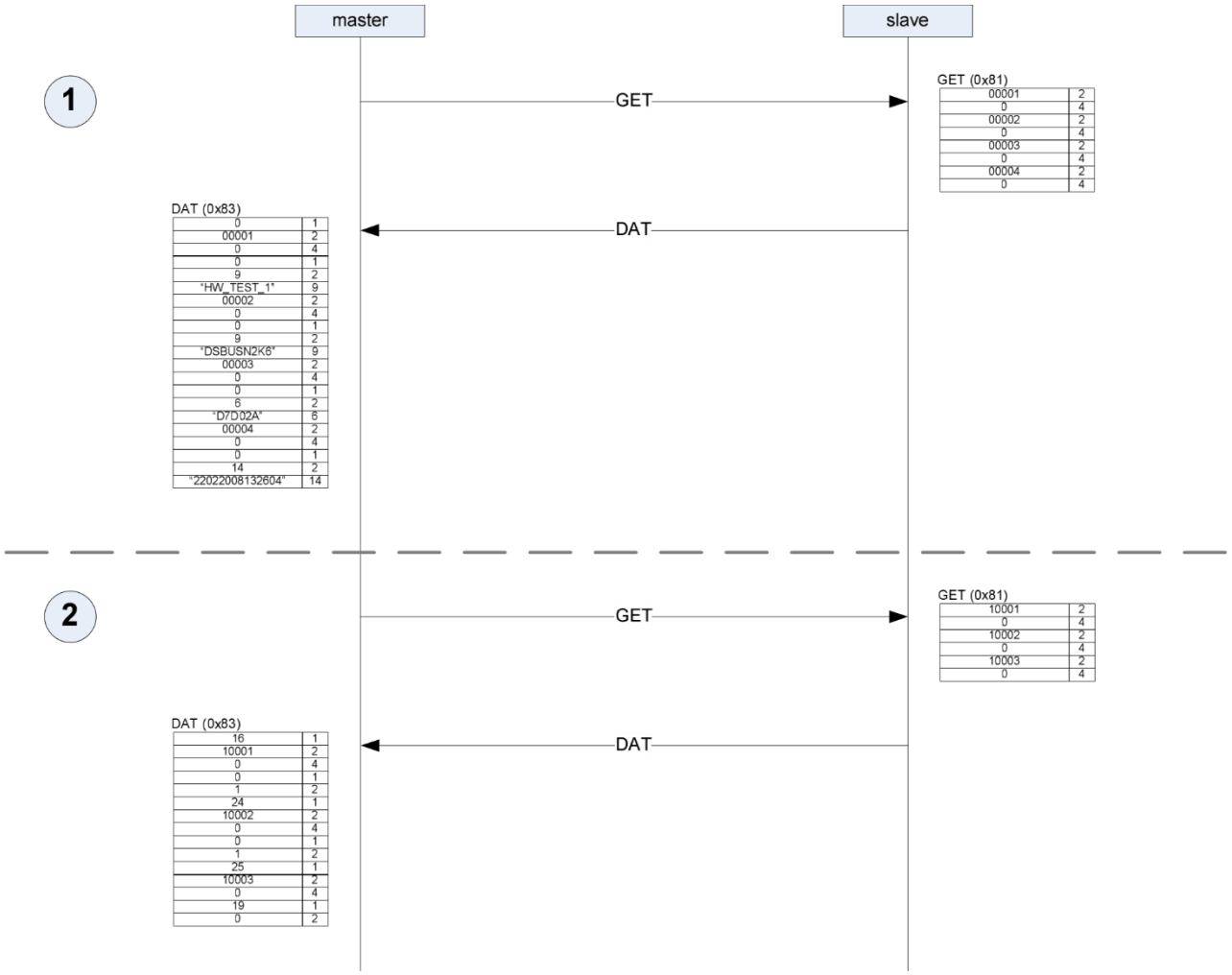


(1) The master asks hardware and firmware information to the slave (codes 00001, 00002, 00003, 00004); the slave correctly answers with the following information (in order): "HW_TEST_1", "DSBUSN2K6", "D7D02A", "22022008132604".

(2) The master wants to read the actual value of temperature sensor from #1 to #3, but unfortunately sensor #3 cannot be read (due to HW problem perhaps); please take a look at the value of the status flag in the DAT answer and the value of flags field for code "10003". Temperature #1 and #2 were 24° and 25°.



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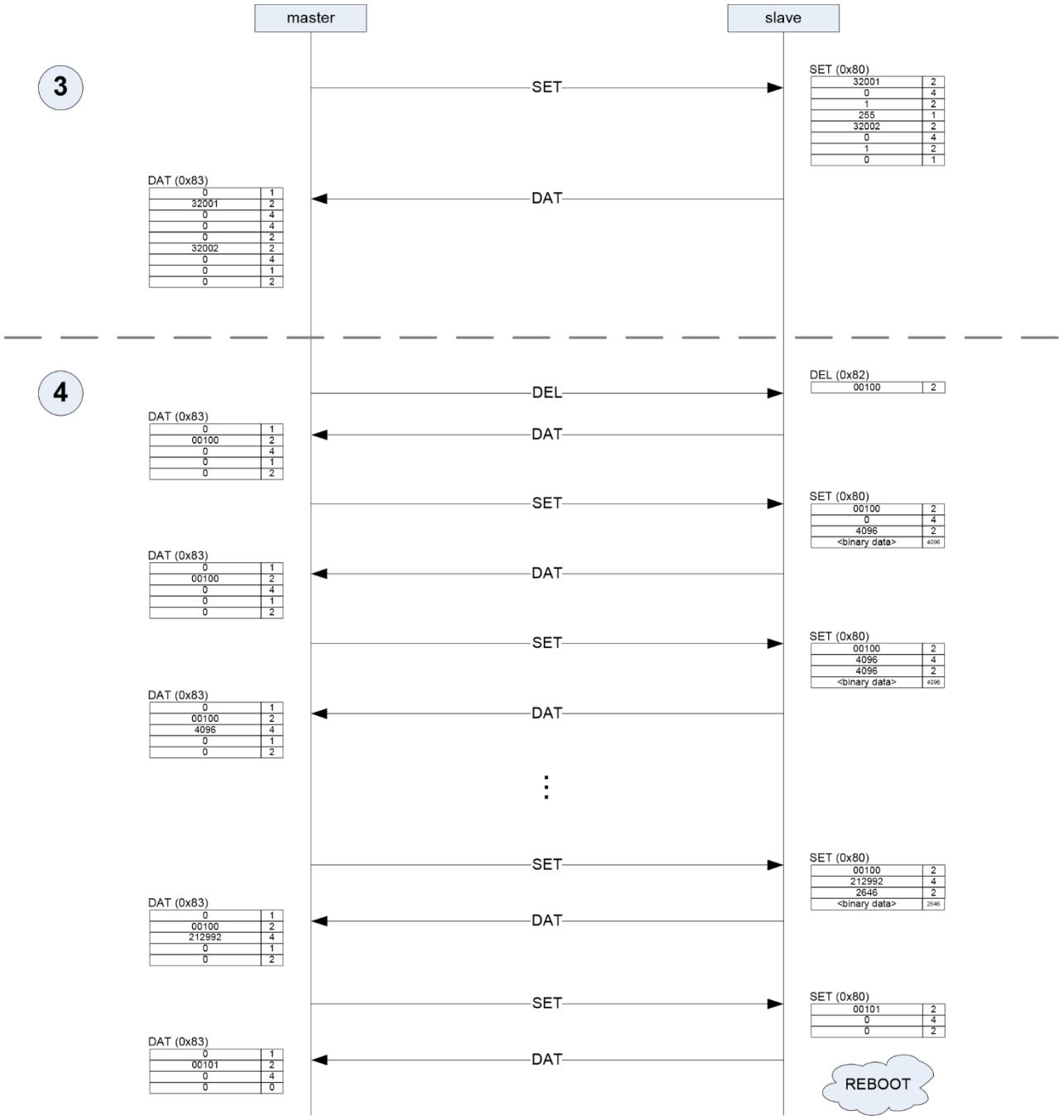


(3) Master sets a brightness value of 255 (maximum) on BRIGHTNESS_1, while sets automatic brightness for BRIGHTNESS_2

(4) This scenario shows the firmware update procedure. The firmware binary to be uploaded to the device can be seen as a "long field", that must be uploaded piece by piece, before applying it. First of all, the content of FIRMWARE_UPGRADE_BUFFER field is deleted, to start uploading from scratch. Then the firmware binary is uploaded using 4KB packets (in our example let's suppose that the firmware is long 215638 bytes, so that the transfer will be composed by 52



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packets (4096-byte-long) and a final smaller packet (2646 bytes). The process of reboot is accomplished writing to field 00101 (APPLY_FIRMWARE_AND_RESET).



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# Appendix 11 – MANTAM operational concept and processes

10 This chapter outlines the operational concept of the MANTAM. It provides an overview of the key operational processes that take place within the MANTAM framework. The Metropolitan Urban Traffic Control system (MUTC) is expected to actively participate in these processes, operating in coordination with other traffic management systems integrated into the MANTAM. The Supplier shall ensure that the MUTC is fully aligned with the defined MANTAM operational workflows and protocols.

## 10.1 General

The operational concept is based on four main processes:

10.1.1 Traffic Response Plans planning – Planning and defining the required traffic level of service (LOS), per road segment and time, and specifying the standard traffic plans, to be executed in normal traffic flow conditions, and Response Plans to be executed to handle expected and unexpected events (Incidents).

10.1.2 Traffic situation picture –

10.1.2.1 Building traffic situation picture of all metropolitan area roads.

10.1.2.2 Disseminating the traffic situation picture to relevant clients – systems and end users.

10.1.3 Traffic management and control - Management and control processes that cover all operator responses for handling traffic exceptions, Incidents and pre-planned events, LOS degradations, and anomalies in traffic behavior.

10.1.4 Debriefing, statistics, and research - Debriefing and research processes of both real-time and post-analytics of traffic exceptions to improve traffic management.

## 10.2 Main operational processes

The following sections describe each of the main MANTAM operational processes:

10.2.1 Traffic Response Plans planning



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The Response Plans planning process includes the definition and setting of pre-defined traffic plans for normal traffic flow conditions and Response Plans to be executed according to any exceptions – Incidents, events, and degradation of traffic metrics.

### 10.2.2 Traffic situation picture – build and disseminate

The traffic situation picture process aims to gather all relevant traffic and traffic-supportive information from sensors, traffic devices, external traffic control centers, municipalities, emergency agencies, environment sources, etc., and produce insights about traffic status.

The following diagram describes the sources of the traffic situation view:

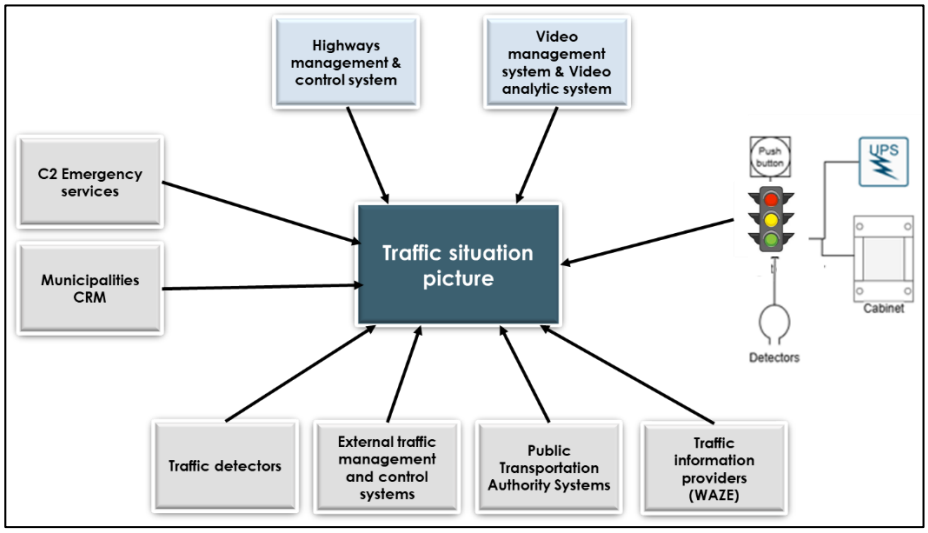


*Figure 2 - Traffic situation picture sources*

The collected data is filtered, arranged, aggregated, fused, processed, and presented to the operators to provide a traffic situation view of all controlled roads in the metropolitan area.

The process also includes calculating (see below the process of traffic analysis), storing the traffic matrices and LOS calculation results, and storing reports of traffic Incidents and traffic events.

The traffic situation picture is disseminated to all relevant clients, internal and external, and it is displayed to the relevant MANTAM operators and users.

### 10.2.3 Traffic Management and Control

The traffic management and control processes include all activities conducted by the MANTAM operators as a response to traffic exceptions (events, Incidents, anomalies in traffic flow, etc.) that need to be handled.



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These activities include modifications in traffic device plans (based on the selection of pre-defined plans or by other methods described in this document), e.g., traffic lights controllers and road messaging signs, prioritization of public transportation, and activation and coordination of field forces, e.g., rangers and emergency forces.

#### 10.2.4 Traffic debriefing and analysis

The debriefing and analysis include several post and online processes which aim to improve MANTAM traffic management operations.

These processes include:

- Traffic exceptions analysis – Usually with regards to post occurrence of events, Incidents of traffic flow anomalies.
- Traffic statistics calculations – Online and offline calculation per area \ road segments and time frames.
- Periodic shift debriefing – Daily, weekly, monthly, or yearly debriefing.
- Online analysis – Implementing advanced analytic tools to anticipate upcoming events and give recommendations to required responses.

## 10.3 Organizational Structure

The MANTAM is a subordinate organization within the Operation and Maintenance Division of AHCo, reporting to the Traffic Management and Control wing. The following units and officials are related both to MANTAM Dan and MANTAM HaMifratz, unless stated otherwise.

### 10.3.1 MANTAM units

#### 10.3.1.1 Traffic Management unit –

The traffic management unit is composed of traffic operators. Their goal is to implement the traffic management policy using the UTC system (currently AVIVIM UTC) and HTMS systems and by coordination with additional traffic management partners. They monitor the traffic flow in real-time and oversee the traffic management and control means, such as the traffic lights operations, and their ability to supply the demand. In response, the traffic operators actuate the traffic management means to improve the traffic flow (for example: changing between traffic control timing plans), manage traffic Incidents, deploy traffic patrollers, coordinate with the traffic police, and call for maintenance units as needed.

#### 10.3.1.2 Traffic planning unit –

The traffic planning unit is composed of traffic engineers. Their purpose is to plan and improve the flow of traffic and the response to traffic demands



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in the metropolitan area. The traffic planning system collects information and data through traffic controllers, traffic sensors, and various systems for collecting traffic information. The unit analyzes the data and concludes the response to existing and future demands. Also, the traffic planning unit is responsible for responding to various events affecting traffic in the metropolitan area. These events include planned events (cultural events, holidays, and national days) as well as responses to Incidents.

10.3.1.3 Maintenance unit –

The AHCo maintenance unit monitors systems and devices availability, responds to Malfunctions, and implements preventive maintenance for the MANTAM systems and Outstation Devices, such as the traffic controllers, traffic cameras, and other Outstation Devices in the metropolitan area. For this purpose, the unit also employs subcontractors who operate by strict service standards.

10.3.1.4 Information technology unit –

The team is composed of IT specialists and systems engineers who provide information technology solutions that are specifically designed to meet the needs of the MANTAM. The information technology unit is responsible for the design and implementation of the network infrastructure, the periodic testing of the systems, and the operation of a local testing environment.

10.3.2 Organization officials

10.3.2.1 Director of Traffic management and control wing – responsible for all operations of the traffic control centers including MANTAM Dan and MANTAM HaMifratz.

10.3.2.2 Director of MANTAM– responsible for all activities of the MANTAM. The director is in charge of all four units described above.

10.3.2.3 Control room manager - responsible for the traffic operators' operation and the management of complex events (planned or Incidents).

10.3.2.4 Traffic engineer – responsible for the establishment of traffic policies, the establishment of LOS and metrics thresholds, and the development of traffic plans for both normal and abnormal traffic conditions, including traffic light plans. The traffic planning unit is under the supervision of the traffic engineer.

10.3.2.5 Traffic operators –responsible for monitoring the traffic flow events and



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Incidents in all managed routes and Signalized Intersections, monitoring the operation of the Traffic Management Devices, such as the traffic light controllers and any other device connected to the controllers. The operators activate the Response Plans, for example, the changing between traffic light plans to relieve traffic congestion, and also deploy maintenance teams to fix Malfunction in the Outstation Devices.

10.3.2.6 System admin - responsible for managing all the MUTC configurations including managing users' groups, permissions, updating metadata, and configuration entities. In addition, the system admin helps to identify problems and Malfunctions in the MUTC and will contact the relevant support team.

10.3.2.7 System engineer & IT engineer – responsible for overseeing the implementation, maintenance, and operations of all MANTAM systems and IT infrastructure.

10.3.2.8 Head of the administration of authorities' connection (MANTAM Dan only) – responsible for all activities for signing agreements with municipalities and connecting the traffic light controllers to the MANTAM.

10.3.2.9 Manager of the communication infrastructure and Outstation Devices (MANTAM HaMifratz only) - responsible for the establishment and maintenance of the communication infrastructures for the Outstation Devices and traffic management Outstation Devices (e.g. traffic light controller, camera, detectors).

10.3.3 Related peer organizations

The MANTAM maintains working relationships with many external organizations involved in traffic control and management processes. The main peer organizations include (partial list):

10.3.3.1 IMOT

10.3.3.2 Local municipalities

10.3.3.3 NTA

10.3.3.4 NATI

10.3.3.5 Israel Police

10.3.3.6 Public Transportation operators

10.3.3.7 "Fast lane" project operators



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# Appendix 12 – JNet traffic Light Timing Plan parameters

| Comment | Parameter description / options | Units | TCS NAME | LRT Lexicon name | אופציה לשינוי ממרכז הבקרה על ידי מנהל משמרת |
|---|---|---|---|---|---|
| | axl ver number/ INBAR file name | | **DesignVer** | | גרסת קובץ התכנון |
| | Version Number of the current set of parameter | Number | **ParmVer** | ParmVerNo | מספר גירסת הפרמטרים לצומת זה |
| **120 Max, above only in special cases according** | Maximum aloud Cycle for soft GW or Isolated SI for LRT/BRT | sec. | **LcMax** | LCmax | זמן מחזור מקסימלי |
| **Used in fix cycle SI's or for rigid coordination** | Cycle length (for LRT assigned for rigid coordination GW) | sec. | **CycleTime** | FCL | זמן מחזור |
| **1-true, 0 - false** | used for level of priorty to be employed with LOS | Boolean | **PeakHourFlag** | Peak | מקדם העדפה |
| **Number of sec' from cycle begin ('0')** | Green Wave Offset assigned for rigid GW SI's | sac. | **GreWavOffset** | GreWavOffset: | אופסט גל ירוק |
| **Code:0-Isolated, 1-RigidGW, 2-SoftGW** | Operation Mode of the intersection controller | Number | **OperMode** | OperMode | אינפורמטיבי בלבד- תפעול גל/עצמאי |
| **not to be change** | The Minimum Headway between LRV for Priority | sec. | **CT_Qmin** | ctQmin | מרחק בטיחות בין רכבות |
| **not to be change** | Early Start of Green Before LRT arriving at stop line | sec. | **GBL** | GBL | זמן פתיחת ירוק לפני הגעה לקו עצירה |
| **not to be change** | MOT GUIDELINES | sec | **Sec** | sec | זמן בטיחות לבדיקת זמני מחזור |
| | Minimum GT for stage X/move y -End Time | sec. | **GT_Min_X/y_EndTime** | GTmin_X/y | זמן מינימום לתמונה/מופע-שנייה במחזור |
| | Minimum GT for stage X/move y -Duration | sec. | **GT_Min_X/y_Duration** | GTmin_X/y | זמן מינימום לתמונה/מופע-משך |
| | SPECISAL_Minimum GT for stage X/move y -End Time | sec. | **GT_MinSpec_X/y_EndTime** | GTmin_X/y | זמן מינימום מיוחד לתמונה/מופע לחציה רציפה-שנייה במחזור |
| | SPECISAL_Minimum GT for stage X/move y -Duration | sec. | **GT_MinSpec_X/y_Duration** | GTmin_X/y | זמן מינימום מיוחד לתמונה/מופע לחציה רציפה-משך |
| | | | **GT_Need_X/y** | GTneed_X/y/GTneed_GG | |
| **Duration length** | Needed GT for stage X/move y | sec. | | TGroup | זמן ירוק דרוש לתמונה/מופע )פיצוי-(משך |
| | Maximim GT for stage X/move y-End Time | sec. | **GT_Max_X/y_EndTime** | GTmax_X/y | זמן מקסימום לתמונה/מופע-שנייה במחזור |
| | Maximim GT for stage X/move y-Duration | sec. | **GT_Max_X/y_Duration** | GTmax_X/y | זמן מקסימום לתמונה/מופע-משך |
| | Special_Maximim GT for stage X/move y-End Time | sec. | **GT_MaxSpec_X/y_EndTime** | GTmax_X/y | זמן מקסימום לתמונה/מופע למקרים מיוחדים-שנייה במחזור |
| | Special_Maximim GT for stage X/move y-Duration | sec. | **GT_MaxSpec_X/y_Duration** | GTmax_X/y | זמן מקסימום לתמונה למיקרים מיוחדים-משך |
| **End Time** | Minimum GT stage X/move y -without LRT | sec. | **GT_Comf_X/y_EndTime** | GTcomf_X/y | זמן מינימום ללא רק"ל - ללא פגיעה בהעדפה-שניה במחזור |
| **Duration length** | Minimum GT stage X/move y -without LRT | sec. | **GT_Comf_X/y_Duration** | GTcomf_X/y | זמן מינימום ללא רק"ל - ללא פגיעה בהעדפה-משך |
| **Sec' Duration length** | Minimum time from DM to DS | sec. | **TGM_y_Min** | tGjmin | זמן הגעה בין גלאי דילמה DM לגלאי קו עצירה DS |
| **Sec' Duration length** | Maximum Time Out from DM to DS | sec. | **TGM_y_Max** | tGjmax | זמן מקסימום לאיפוס מונה בין גלאי דילמה DM לגלאי קו עצירה DS |
| Set value for internal detector timer / counter | LRT/PT DQ expected time for arrival of Movement Y | sec. | **DQ_ETA_y** | TQj | זמן הגעה בין גלאי קו עצירה DS לגלאי ביטול DQ |
| Set value for internal detector timer / counter | LRT/PT DL expected time for arrival of Movement Y | sec. | **DL_ETA_PT_y** | TLj | זמן הגעה בין גלאי רחוק DL לקו עצירה |
| Set value for internal maximum waiting timer | LRT/PT DL Maximum wait time for Movement X | sec. | **DL_MaxETA_PT_y** | tLjmax | זמן מקסימום לאיפוס מונה גלאי רחוק DL |
| Set value for internal detector timer / counter | LRT/PT DP expected time for arrival of Movement X | sec. | **DP_ETA_PT_y** | TPj | זמן הגעה בין גלאי קרוב DP לקו עצירה |
| Set value for internal maximum waiting timer | LRT/PT DP Maximum wait time for Movement X | sec | **DP_MaxETA_PT_y** | tPjmax | זמן מקסימום לאיפוס מונה גלאי קרוב DP |
| Set value for internal maximum waiting timer | LRT/PT DM Maximum wait time for Movement X | sec | **DM_MaxETA_PT_y** | tMjmax | זמן מקסימום לאיפוס מונה גלאי דילמה DM |
| Set value for internal maximum waiting timer | LRT/PT DS Maximum wait time for Movement X | sec | **DS_MaxETA_PT_y** | tSjmax | זמן מקסימום לאיפוס מונה גלאי קו עצירה DS |
| | 0-off 1-on 2-auto | | **Dm_y** | | מצב גלאי:<br>0 - גלאי לא נדרש )מבוטל( 1 - גלאי בדרישה קבועה<br>2 - גלאי בדרישה רגילה ע"פ הנדרש במופע |
| | 0-off 1-on 2-auto | | **Ex_y** | | מצב גלאי:<br>0 - גלאי לא נדרש (מבוטל)<br>1 - גלאי בדרישה קבועה<br>2 - גלאי בדרישה רגילה ע"פ הנדרש במופע |
| | 0-off 1-on 2-auto | | **Ped_y** | | מצב גלאי:<br>0 - גלאי לא נדרש (מבוטל)<br>1 - גלאי בדרישה קבועה<br>2 - גלאי בדרישה רגילה ע"פ הנדרש במופע |



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| | | | | | |
|---|---|---|---|---|---|
| free parameter | General purpose param for coordination/gridlock/OCC and other | sec. | X1 | free parameters | פרמרטים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X2 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X3 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X4 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X5 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X6 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X7 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X8 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X9 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X10 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X11 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X12 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X13 | | פרמטרים חופשיים |
| | General purpose param for coordination/gridlock/OCC and other | sec. | X14 | | פרמטרים חופשיים |



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# Appendix 13 – Examples of applying traffic management modes using the hierarchy model.

Here are some examples of how MUTC could apply traffic management modes based on the hierarchy model.

The examples are based on the following setup

## 1. Setup

### 1.1. Signalized Intersections setup

The MUTC manages four (4) Signalized Intersections which have IDs 1, 2, 3 and 4.

For each Signalized Intersections the users defined traffic light weekly schedule including operation layouts, a weekly schedule for operation layouts, and Special dates operation layout.

#### 1.1.1. Signalized Intersection 4

Specifically, for Signalized Intersection 4 the user defined the following

##### 1.1.1.1. Operation layout of Signalized Intersection 4

| Operation layout 1 | | Operation layout 2 | | Operation layout 3 | |
|---|---|---|---|---|---|
| Purpose: working days | Traffic Light Timing Plan | Purpose: Friday | Traffic Light Timing Plan | Purpose: Saturday | Traffic Light Timing Plan |
| 00:00-05:00 | 5 | 00:00-06:00 | 5 | 00:00-07:00 | 5 |
| 05:00-11:30 | Adaptive | 06:00-12:00 | Adaptive | 07:00-18:00 | 4 |
| 11:30-16:00 | 4 | 12:00-15:30 | 22 | 18:00-00:00 | 22 |
| 16:00-19:30 | 22 | 15:30-00:00 | 8 | | |
| 19:30-22:00 | Adaptive | | | | |
| 22:00-00:00 | 8 | | | | |

##### 1.1.1.2. A weekly schedule for operation layouts of Signalized Intersection 4.

| Day of week | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|---|
| Operation layout to execute | 1 | 1 | 1 | 1 | 1 | 2 | 3 |



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## 1.2. Sub-Networks setup

The users defined two Sub-Networks. A Sub-Network called "A" which includes Signalized Intersection 1, 2 and 3. And a Sub-Netowrk called "B" for Signalized Intersection 4.

### 1.2.1. Sub-Network "A"

#### 1.2.1.1. Sub-Network "A" has the following coordinated timing plan board

| Coordinated board name | Signalized Intersection 1 timing plans | Signalized Intersection 2 timing plans | Signalized Intersection 3 timing plans |
|---|---|---|---|
| Morning | 12 | 14 | 16 |
| Evening | 5 | 5 | 10 |
| Evacuating | 14 | 13 | 18 |

#### 1.2.1.2. Sub-Network "A" 's weekly schedule for coordinated timing boards is

| Sunday | | Monday | | Tuesday | | Wednesday | | Thursday | | Friday | | Saturday | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinat timing bo |
| 00:00-05:00 | Morning | 00:00-05:00 | Morning | 00:00-05:00 | Morning | 00:00-05:00 | Morning | 00:00-05:00 | Morning | 00:00-06:00 | Morning | 00:00-07:00 | |
| 05:00-11:30 | Adaptive | 05:00-11:30 | Adaptive | 05:00-11:30 | Adaptive | 05:00-11:30 | Adaptive | 05:00-11:30 | Adaptive | 06:00-12:00 | Morning | 07:00-18:00 | Mornin |
| 11:30-16:00 | Morning | 11:30-16:00 | Adaptive | 11:30-16:00 | Adaptive | 11:30-16:00 | Evacuating | 11:30-00:00 | Evening | 12:00-15:30 | Evening | 18:00-00:00 | Evenin |
| 16:00-19:30 | Evacuatin | 16:00-19:30 | Evacuatin | 16:00-19:30 | Evacuatin | 16:00-00:00 | Evening | | | 15:30-00:00 | Evening | | |
| 19:30-00:00 | Evening | 19:30-22:00 | Evening | 19:30-00:00 | Evening | | | | | | | | |
| | | 22:00-00:00 | Adaptive | | | | | | | | | | |

### 1.2.2. Sub-network "B"

Signalized Intersection 4 belongs to Sub-network "B". Sub-network "B" does not have a weekly schedule for coordinated timing board.



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## 1.3. Configurations setup

The users defined 3 Configurations called "C-A", "C-B", and "C-C".

### 1.3.1. Configuration "C-A"

Configuration "C-A" includes Sub-Network "A".

#### 1.3.1.1. Configuration "C-A" 's coordinated boards

| Coordinated board name | Sub-Network "A" Coordinated board | | |
|---|---|---|---|
| C_Morning | Morning | | |
| C_Evening | Evening | | |
| C_Evacuating | Evacuating | | |

#### 1.3.1.2. The weekly schedule for Coordinated boards of Configuration "C-A".

| Sunday | | Monday | | Tuesday | | Wednesday | | Thursday | | Friday | | Saturday | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinated timing board | | coordinat timing bo |
| 00:00-05:00 | C_Morning | 00:00-05:00 | C_Morning | 00:00-05:00 | C_Morning | 00:00-23:59 | | 00:00-23:59 | | 00:00-06:00 | Adaptive mode | 00:00-07:00 | Adaptiv mode |
| 05:00-11:30 | C_Evacuating | 05:00-11:30 | Adaptive mode | 05:00-11:30 | Adaptive mode | | | | | 06:00-12:00 | C_Morning | 07:00-18:00 | C_Morni |
| 11:30-16:00 | C_Morning | 11:30-16:00 | Adaptive mode | 11:30-16:00 | Adaptive mode | | | | | 12:00-15:30 | C_Evening | 18:00-00:00 | C_Eveni |
| 16:00-19:30 | Adaptive mode | 16:00-19:30 | Adaptive mode | 16:00-19:30 | Adaptive mode | | | | | 15:30-00:00 | C_Evening | | |
| 19:30-22:00 | C_Evening | 19:30-22:00 | Adaptive mode | 19:30-00:00 | | | | | | | | | |
| 22:00-00:00 | Adaptive mode | 22:00-00:00 | Adaptive mode | | | | | | | | | | |

### 1.3.2. Configuration "C-B"

Sub-Network "B" is part of Configuration "C-B", but the users have not set up coordinated boards or a schedule for them.

### 1.3.3. The configurations activation plan is

| Sunday | | Monday | | Tuesday | | Wednesday | | Thursday | | Friday | | Saturday | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Configurations | | Configurations | | Configurations | | Configurations | | Configurations | | Configurations | | Configura ns |
| 00:00-12:00 | "C-A" "C-B" | 00:00-05:00 | "C-A" "C-B" | 00:00-12:00 | "C-A" "C-B" | 00:00-12:00 | "C-C" | 00:00-12:00 | "C-C" | 00:00-12:00 | "C-C" | 00:00-07:00 | "C-A" "C-B" |
| 12:00-16:00 | "C-A" "C-B" | 05:00-11:30 | "C-C" | 12:00-16:00 | "C-A" "C-B" | 12:00-16:00 | "C-C" | 12:00-16:00 | "C-C" | 12:00-16:00 | "C-A" "C-B" | 07:00-18:00 | "C-A" "C-B" |
| 16:00-00:00 | "C-A" "C-B" | 11:30-16:00 | "C-C" | 16:00-00:00 | "C-A" "C-B" | 16:00-00:00 | "C-C" | 16:00-00:00 | "C-C" | 16:00-00:00 | "C-C" | 18:00-00:00 | "C-C" |



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2. Example 1
   - The current date is Sunday at 16:00 o'clock.
   - The system checks in the Configuration activation plan (1.3.3) which configurations are active and decides that Configuration "C-A" and Configuration "C-B" are active.
   - The system checks if a coordinate board is set in the weekly schedule of the Configuration "C-A" (1.3.1.2) and finds out "adaptive mode" is set to run on Sunday 16:00.
   - Configuration "C-A" includes Sub-Network "A" (1.3.1). Sub-Network "A" consists of Signalized Intersections 1, 2, and 3. The system will run these Signalized Intersections in centralized adaptive mode.
   - For Configuration "C-B" (1.3.2), the system does not have any Configuration level instructions for scheduling. The system will check the definition for Sub-Network "B" (1.2.2). It finds out Sub-Network "B" also does not include scheduling instructions. Then the system will check the Signalized Intersection schedule. Only Signalized Intersection 4 is part of Sub-Network "B". For Signalized Intersection 4, on Sunday operation layout 1 should be run (1.1.1.2). And in operation layout 1 at 16:00 o'clock Traffic Light Timing plan 22 should run (1.1.1.1). So, the system instructs the traffic controller of Signalized Intersection 4 to run plan 22.
3. Example 2
   - The current date is Saturday at 07:30 o'clock.
   - The system checks in the Configuration activation plan (1.3.3) which configurations are active on Saturday at 07:30 and decides that Configuration "C-A" and Configuration "C-B" are active.
   - The system checks which coordinate board is set on Saturday at 07:30 in the weekly schedule of the Configuration "C-A" and finds out it should run coordinated board "C-Morning" (1.3.1.2). The coordinated board "C-Morning" defines that for Sub-Network "A" it should run "Morning" coordinated board" (1.3.1.1). The coordinate board "Morning" of Sub-Network "A" instructs the system to run Signalized Intersection 1 with Traffic Timing plan 12 (1.2.1.1), Signalized Intersection 2 with Traffic Timing plan 14, and Signalized Intersection 3 with Traffic Timing plan 16.
   - As in example 1, Configuration "C-B" and its Sub-Network "B" does not include instructions (1.3.2, 1.2.2), so the system checks the weekly schedule of Signalized Intersection 4 (1.1.1.2). For Signalized Intersection 4, on Saturday operation layout 3 should be run. And in operation layout 3 at 07:30 o'clock the system needs to run the Signalized Intersection with Traffic Timing plan 4 (1.1.1.1).



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4. Example 3
   - The current date is Tuesday at 20:00 o'clock.
   - The system checks in the Configuration activation plan which configurations are active on Tuesday at 20:00 and decides that Configuration "C-A" and Configuration "C-B" are active (1.3.3).
   - The system checks which coordinate board is set on Tuesday at 20:00 in the weekly schedule of the Configuration "C-A" and finds out there is no definition (1.3.1.2). So, the system checks the Sub-networks definitions.
   - Sub-Network "A" is part of Configuration "C-A". The weekly schedule for coordinated timing boards of Sub-Network "A" instructs the system to run coordinated timing board "Evening" (1.2.1.2). The "Evening" coordinated timing board of Sub-Network "A" instructs the system to run Signalized Intersection 1 with Traffic Timing plan 5, Signalized Intersection 2 with Traffic Timing plan 5, and Signalized Intersection 3 with Traffic Timing plan 10 (1.2.1.1).
   - As in example 1, Configuration "C-B" and its Sub-Network "B" does not include instructions (1.3.2, 1.2.2), so the system checks the weekly schedule of Signalized Intersection 4. For Signalized Intersection 4, on Tuesday operation layout 1 should be run (1.1.1.2). And in operation layout 1 at 20:00 o'clock the system needs to run the Signalized Intersection in centralized Adaptive mode (1.1.1.1).



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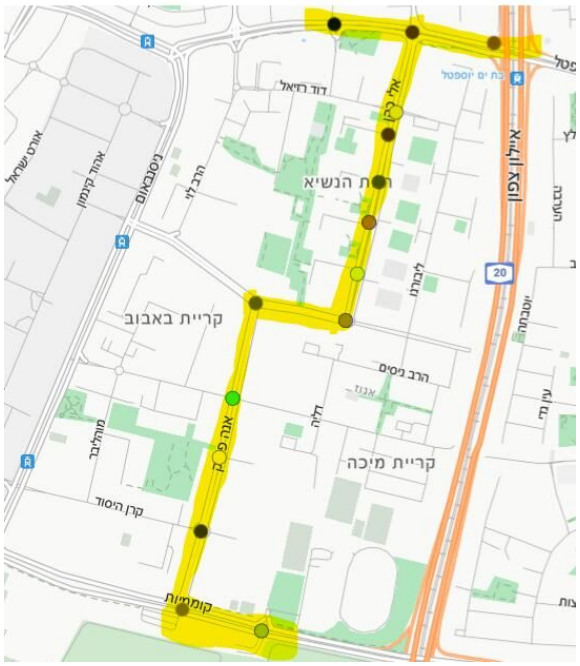
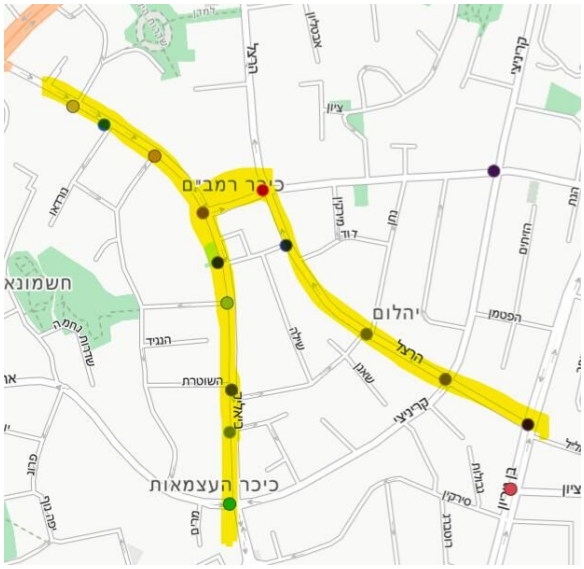
# Appendix 14 – Candidate sub-networks of Signalized Intersection to participate in the centralized adaptive traffic management POC

As part of the centralized adaptive traffic management POC, AHCo is considering managing one of the following sub-networks of signalized intersections by the centralized adaptive traffic management module.

**City**: Bat-Yam **Route**: Eli Cohen st + Anne Frank st




**City**: Ramat-Gan **Route**: Bialik st + Herzl st



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# Appendix 15 – Modbus protocol for ITC3

Swarco Technology ApS

C. F. Tietgens Boulevard
25
DK-5220 Odense SØ
Denmark

TEL: +45-63-152-200
E-MAIL: office.technology@swarco.com
URL: www.swarco.com



## Contents

## 1.2 Modbus 2.1

Select modbus variation 2.1, by setting F32AN7 to 21. See Swarco Modbus protocol considerations.

The following abbreviations are used in this section:

| | |
|---|---|
| LSB | Least significant byte of 16 bit modbus register. |
| MSB | Most significant byte of 16 bit modbus register. |

The ITC implementation of modbus only use holding registers for operational data. Registers are set in a readable and a writeable section. The writeable registers are not meant to be readable as well as they overlap differently with the readable section.

The input register layout holds only meta information about protocol version.

### 1.2.1 Assumptions

In several cases this protocol have been extended with space for up to 96 signal groups as it is expected that a later time, the controller will have support for up to 96 signal groups. However, in reality at the time of this writing, the controller only is able to support 48 physical groups and up 64 if virtual groups are injected for the remaining groups.

### 1.2.2 Overview of input registers layout

The only register currently available in this region, is the modbus layout version.

| READ INPUT. REG. | DESCRIPTION | |
|---|---|---|
| 65535 | Modbuslayoutversion. | 1.2.4.1 |

Table 69: Readable input registers overview.

### 1.2.3 Overview of Holding registers layout

All registers are primarily held in this region of the modbus protocol. Each read and write register is not matched up against each other and therefore great care must be followed to avoid accidentally writing back into such a register without checking first what is available.

| READ HOLD. REG. | DESCRIPTION |
|---|---|
| 0-1600 | Detector log. 1.2.5.1 |
| 1601-3201 | Lamp log. 1.2.5.1 |
| 3202-4802 | General log. 1.2.5.1 |
| 4803-6403 | Event log. 1.2.5.1 |
| 6404-8004 | Plan log. 1.2.5.1 |
| 8005 | Controller alarm status. 1.2.5.2 |
| 8006 | Backplane ID. 1.2.5.3 |
| 8007 | Logical Address. 1.2.5.4 |
| 8008 | Number of available traffic plans and situations. 1.2.5.5 |
| 8009 | Number of groups and detector logics. 1.2.5.6 |
| 8010-8014 | Current Date and time. 1.2.5.7 |



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8015 . . . . . Current traffic plan and source. 1.2.5.8
8016 . . . . . Current traffic situation and source. 1.2.5.9
8017 . . . . . Local/central mode and control status. 1.2.5.10
8018 . . . . . Coordination status and fixed time/dimming. 1.2.5.11
8019 . . . . . Base cycle counter and plan counter. 1.2.5.12
8020 . . . . . Current plan cycle length. 1.2.5.13
8021 . . . . . Current stage and next Stage. 1.2.5.14
8022-8069 . . . . . Group status. 1.2.5.15
8070-8091 . . . . . Detector status. 1.2.5.16
8092-8113 . . . . . Detector errors. 1.2.5.17
8114-8465 . . . . . Detector counts and occupancy. 1.2.5.21
8466-8529 . . . . . Software flags. 1.2.5.18
8530-8779 . . . . . Memory registers. 1.2.5.19
8780-8787 . . . . . Hardware inputs. 1.2.5.20
8788-8907 . . . . . Control block parameters. 1.2.5.22
8908-12875 . . . . . Traffic plan parameters. 1.2.5.23
12876-13035 . . . . . Traffic plan configuration parameters. 1.2.5.24
13036-25323 . . . . . Traffic plan group configuration parameters. 1.2.5.25
25324-25707 . . . . . Group configuration parameters. 1.2.5.26
25708-31851 . . . . . Stage logic group configuration parameters. 1.2.5.27
31852-31921 . . . . . Calendar General configuration parameters. 1.2.5.28
31922-34993 . . . . . Calendar Timetable configuration parameters. 1.2.5.29
34994-37116 . . . . . Calendar Annual table configuration parameters. 1.2.5.30
37117-37244 . . . . . Calendar Timetable actions configuration parameters. 1.2.5.31

Table 70: Readable holding registers overview.

WRITE HOLD. REG.DESCRIPTION

0-2 . . . . . Current date and time. 1.2.6.1
3 . . . . . Current plan and situation. 1.2.6.2
4 . . . . . Current plan cycle length and fixed time control. 1.2.6.3
5 . . . . . Control intersection. 1.2.6.4
6-13. . . . . .Digital outputs. 1.2.6.5
14-141 . . . . . Software flags. 1.2.6.6
142-391 . . . . . Memory registers. 1.2.6.7
392-567 . . . . . Force detector logics. 1.2.6.8
568-687 . . . . . Control block parameters. 1.2.6.9
688-4655. . . . . .Traffic Plan parameters. 1.2.6.10
4656-4815 . . . . . Traffic plan configuration parameters. 1.2.6.11
4816-17103 . . . . . Traffic plan group configuration parameters. 1.2.6.12
17104-17391 . . . . . Group configuration parameters. 1.2.6.13
17392-23535 . . . . . Stage logic Group configuration parameters. 1.2.6.14
23536-23605 . . . . . Calendar General configuration parameters. 1.2.6.15
23606-26677 . . . . . Calendar Timetable configuration parameters. 1.2.6.16
26678-28789 . . . . . Calendar Annual table configuration parameters. 1.2.6.17
28790-28917 . . . . . Calendar Timetable actions configuration parameters. 1.2.6.18

Table 71: Writeable holding registers overview.

The following pages contains detailed information about the holding and input registers in use.



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### 1.2.4 Readable Input registers descriptions

#### 1.2.4.1 Modbus layout version

| Offset | | Field |
|---|---|---|
| +0 | MSB | Major version |
| | (2) | |
| | LSB | Minor version |
| | (0) | |

### 1.2.5 Readable Holding registers descriptions

#### 1.2.5.1 ITC Logs

- 0-1600, Detector log.
- 1601-3201, Lamp log.
- 3202-4802, General log
- 4803-6403, Event log.
- 6404-8004, Plan log.

Each log is arranged with the first register containing number of log entries present in the remaining registers. All remaining registers are set to zero.

Therefore each log is laid out as follows:

| Offset | Field |
|---|---|
| +0 | Count of log entried (0-200) |
| +1-+8 | Log |
| entry 1 | |
| +9-+16 | Log |
| entry 2 | |
| ... | *etc.* |

And each log entry follows the following scheme:

| Offset | | Field |
|---|---|---|
| +0 | LSB | Timestamp, month (1-12). |
| | MSB | Timestamp, year - 2000. |
| +1 | LSB | Timestamp, hour (0-23). |
| | MSB | Timestamp, day (1-31). |
| +2 | LSB | Timestamp, second (0-59). |
| | MSB | Timestamp, minute (0-59). |
| +3 | | Error code. |
| +4 | | error info 1. |
| +5 | | error info 2. |
| +6 | | error info 3. |
| +7 | | error info 4. |

The amount of lines per log is limited to the 200 latest entries.



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1.2.5.2 Short alarm status

Field providing general information about alarm status in order to avoid having to iterate current alarm list.

| Offset | Group |
|---|---|
| b0-1 | Short alarm state:<br>0 - no alarms<br>1 - minor alarm<br>2 - major alarm<br>3 - major alarm, dark signals. |
| b2 | Lamps level error |
| b3 | Detector error |
| b4-15 | Reserved |

1.2.5.3 Backplane ID

ITC backplane ID, as read from the backplane ID chip.

1.2.5.4 Logical Address

Logical address read from F029N4.

1.2.5.5 Number of available traffic plans and situations

| Offset | Field |
|---|---|
| MSB | Number of configured traffic situations read from F999N6 |
| LSB | Number of configured traffic plans read from F999N5 |

1.2.5.6 Number of groups and detector logics

| Offset | Field |
|---|---|
| MSB | Number of detector logics read from F000N4 |
| LSB | Number of groups read from F000N1 |

1.2.5.7 Current date and time

| Offset | | Group |
|---|---|---|
| +0 | MSB | Year - 2000. |
| | LSB | Month (1-12) |
| +1 | MSB | Day (1-31) |
| | LSB | Hour (0-59) |
| +2 | MSB | Minute (0-59) |
| | LSB | Second (0-59) |

1.2.5.8 Current traffic plan and source



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Offset Field

LSB Current traffic plan (1-32).
- 254 Flash.
- 255 Dark.

MSB Plan source - one of:
- 0 default (plan 1)
- 1 forced
- 2 failure mode
- 3 manual
- 4 local
- 5 emergency
- 6 work station
- 7 control block
- 8 calendar clock
- 9 external traffic-plan-master TPm (parallel)
- 10 external traffic-plan-master TPm (serial)
- 11 internal traffic-plan-master TPm (traffic actuation)
- 12 current traffic situation
- 13 start-up
- 14 UTC
- 15 start-up (high priority)
- 16 Smart Plan
- 17 Mode priority

1.2.5.9 Current traffic situation and source

Offset Field

LSB Current traffic situation (1-x).

MSB Situation source - one of
- 0 default (situation 1)
- 1 forced
- 2 emergency
- 3 work station
- 4 control block
- 5 external traffic-situation-master TSm (parallel)
- 6 external traffic-situation-master TSm (serial)
- 7 internal traffic-situation-master TSm (traffic actuation)
- 8 calendar clock
- 9 startup

1.2.5.10 Local/central mode and control status

Offset Field

LSB Local/central mode.
- 0 Local.
- 1 Central.
- 2 Local requested from manual panel.

MSB Control status.
- 0 Isolated.
- 1 (RESERVED).



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2 Coordination.
3 Special coordination (SPOT,OCIT) or centralized.
4 Manual.
5 All red.
6 Local coordination/linked.

1.2.5.11 Coordination status and fixed time/dimming

Offset Field
LSB Coordination status. Bitmask.
+1 Coordination is active.
+2 Coordination and sync is active.
+4 Sync signal is active.
+8 Waiting for sync signal.
+16 Warning in sync signal.
+32 Fault in sync signal.
+64 Coordination with sync is used.
MSB mode.
0 Normal.
1 Fixed time.
2 Dimming active.

1.2.5.12 Base cycle counter and plan counter

This single register is layed out as follows:

Offset Field
LSB Base cycle counter (0-x).
MSB Plan cycle counter (0-x).

1.2.5.13 Current plan cycle length

The current plan cycle length is a representation of the currently active cycle length. However, the cycle may be longer/shorter in order to adopt a change in the cycle length.

Register layout:

Offset Field
LSB (RESERVED).
MSB Current plan cycle time (0-x).

1.2.5.14 Current Stage and next Stage

This single register is layed out as follows:

Offset Field
LSB Current stage.
MSB Next stage.



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#### 1.2.5.15 Group status

Group status for groups 1-96. Each 16 bit register contains status for four groups. Odd numbered groups are in the lower four bits of a byte, and even numbered in the high four bits. For example, the first four groups would occupy a 16 bit register as follows:

| | |
|---|---|
| Bits 0-3 | Group 1. |
| Bits 4-7 | Group 2. |
| Bits 8-11 | Group 3. |
| Bits 12-15 | Group 4. |

Each group can take on the following values:

| | |
|---|---|
| 0 | Red/yellow. |
| 1 | Minimum green. |
| 2 | Green rest. |
| 3 | Green extension. |
| 4 | Past-end green. |
| 5 | Flashing green. |
| 6 | Yellow. |
| 7 | Red clearance or minimum red. |
| 8 | Red rest. |
| 9 | Red with request. |
| 10 | Red priority. |
| 11 | Red priviledge. |
| 12 | Red, stopping conflicts. |
| 14 | Startup, dark or flash. |
| 15 | Not used signal group. |

#### 1.2.5.16 Detector status

Detector logic 1-352 status, one bit per detector logic, 16 per register. The least significant bit in first modbus holding register is detector logic 1.

The bit states are as follows:

| | |
|---|---|
| 0 | Detector logic is inactive. |
| 1 | Detector logic is active. |

#### 1.2.5.17 Detector errors

Detector logic 1-352 errors. One bit per detector logic starting with lowest significant bit being detector 1. The bit states are as follows:

| | |
|---|---|
| 0 | Detector logic has no error. |
| 1 | Detector logic has error. |

#### 1.2.5.18 Software flags

Software flags 1-1024, one bit per flag starting with first software flag is lowest bit in the first register.

The bit states are as follows:



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0 Software flag is inactive.
1 Softare flag is active.

#### 1.2.5.19 Memory registers

Memory registers 1-250. A memory register is a 16 bits sized register inside ITC-3. Each memory register occupies one register in modbus.

#### 1.2.5.20 Hardware inputs

Digital inputs 1-128. Each bit in a register represents a single input. The inputs are ordered lowest to highest so that for instance the first register first bit is input 1 and the highest bit is input 16.

The bit states are as follows:

0 Digital input is inactive.
1 Digital input is active.

#### 1.2.5.21 Detector counts and occupancy

Each register contains volume and occupancy data for a single detector logic. First register is detector logic 1.

LSB Detector volume count (0-255).
MSB Detector occupancy on percent (0-100).

#### 1.2.5.22 Control block parameters

Control block parameters 1-240, from configuration F15N9-F15N248. Each register contains two control block parameters, the least significant byte of first register is control block parameter 1 (F15N9).

LSB Odd control block parameters (1-239).
MSB Even control block parameters (2-240).

#### 1.2.5.23 Traffic plan parameters

Plan parameters, from configuration F36. Each plan has 248 parameters and are sectioned as follows:

| Address | Plan |
|---|---|
| +0 - +123 | Traffic plan 1 parameters |
| +124 - +247 | Traffic plan 2 parameters |
| ... | ... *etc* ... |
| +3844 - +3967 | Traffic plan 32 parameters |

Each modbus holding register each holds 2 plan set registers like so:

| Offset | Group |
|---|---|
| +0 | Traffic Plan 1 parameter 1&2 |
| LSB: | Parameter 1 |
| MSB: | parameter 2 |
| +1 | Traffic Plan 1 parameter 3&4 |
| LSB: | Parameter 3 |



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| | | |
|---|---|---|
| | MSB: | |
| | Parameter 4 ... | |
| ... | | ... *etc* ... |
| +124 | | Traffic Plan 2 parameter 1&2 |

1.2.5.24 Traffic plan configuration parameters

| Address | Group |
|---|---|
| +0 - +4 | Traffic plan cfg 1 |
| +5 - +9 | Traffic plan cfg 2 |
| ... | ... *etc* ... |
| +155 - +159 | Traffic plan cfg 16 |

A single plan uses the following 5 registers

| Offset | | Field |
|---|---|---|
| +0 | | Plan type F03PN1 |
| +1 | MSB: | Start-up stage F03PN2 |
| | LSB: | Rest stage F03PN2 |
| +2 | | Shutdown stage F03PN2 |
| +3 | LSB: | Plan cycle F03PN10 |
| +4 | MSB: | Cycle offset F03PN11 |

1.2.5.25 Traffic plan group configuration parameters

| Address | Group |
|---|---|
| +0 - +383 | Traffic plan 1 |
| +0 - +3 | Traffic plan 1 - Group 1 |
| +4 - +7 | Traffic plan 1 - Group 2 |
| ... | *etc...* |
| +384 - +768 | Traffic plan 2 |
| ... | *etc...* |
| +11904 - +12287 | Traffic plan 32 |

The plan.group scheme is organized as follows:

| Offset | | Field |
|---|---|---|
| +0 | MSB | Max. min. green (1 sec) F07PGN1 |
| | LSB | Max. green (1 sec) F07PGN2 |
| +1 | MSB | Aux time (0.1 sec) F07PGN3 |
| | LSB | Var P-E-G time (0.1 sec) F07PGN4 |
| +2 | MSB | Privelege time (1 sec) F07PGN5 |
| | LSB | Start/stop order mode F07PGN6 |
| +3 | MSB | Sequence logic F07PGN7 |
| | LSB | Stage logic F07PGN8 |

1.2.5.26 Group configuration parameters

| Address | Group |
|---|---|
| +0 - +3 | Group 1 |
| +4 - +7 | Group 2 |
| ... | ... *etc* ... |
| +380 - +383 | Group 96 |



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A single group uses the following registers

| Offset | | Field |
|---|---|---|
| +0 | | Signal type F998GN5 |
| | MSB: | x |
| | LSB: | y |
| +1 | MSB: | Red/Yellow (x0.1 secs) F04GN8 |
| | LSB | Min green (x0.1 secs) F04GN9 |
| +2 | MSB: | Green flash(x0.1 secs) F04GN10 |
| | LSB: | Min Yellow (0.1 secs) F04GN11 |
| +3 | MSB: | Var Yellow (0.1 secs) F04GN12 |
| | LSB: | Min Red (0.1 secs) F04GN13 |

1.2.5.27 Stage logic group configuration parameters

A max of 16 stage logics are programmable. A read from undefined values will yield zero in all cases.

| Address | Group |
|---|---|
| +0 - +383 | Stage logic 1 |
| +0 - +3 | Stage logic 1 - Group 1 |
| +4 - +7 | Stage logic 1 - Group 2 |
| ... | ... *etc* ... |
| +384 - +767 | Stage logic 2 |
| ... | ... *etc* ... |
| +5760 - +6144 | Stage logic 16 |

The Logic.group scheme is organized as follows:

| Offset | | Field |
|---|---|---|
| +0 | MSB: | Req stages F009GN1 |
| | LSB: | Primary stages F009GN2 |
| +1 | LSB: | No-Req stages F009GN3 |
| +2 | | Reserved |
| +3 | | Reserved |

1.2.5.28 Calendar General configuration parameters

| Offset | | Field |
|---|---|---|
| +0 | LSB: | Daylight saving F21N2 |
| +1 | MSB: | Daylight-saving-time begin x F21N3 |
| | LSB: | Daylight-saving-time begin y |
| +2 | LSB: | Daylight-saving-time begin z |
| +3 | MSB: | Daylight-saving-time end x F21N4 |
| | LSB: | Daylight-saving-time end y |
| +4 | LSB: | Daylight-saving-time end z |
| +5 | LSB: | Long saturday F21N5 |
| | MSB: | Special days interval definition. F21N14 |
| +6 - +70 | | Set of Day set 1-32 F21N6 |
| | | *(See below)* |



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The Day set scheme is organized as follows per day set:

| Offset | | Field |
|---|---|---|
| +0 | MSB: | Day set X value |
| | LSB: | Day set X value |
| +1 | LSB: | Day set Z value |

1.2.5.29 Calendar Timetable configuration parameters

List of time table definitions:

| Offset | Field |
|---|---|
| +0-+95 | Time table 1 |
| +96-+192 | Time table 2 |
| ... | ... etc ... |
| +2976 - +3071 | Time table 32 |

Each table defines a function (see F22TN1), repeated 32 times for each table.

| Offset | | Field |
|---|---|---|
| +0 | | Function. |
| +1 | | Hour |
| +2 | MSB: | Minute |
| | LSB: | Seconds |

1.2.5.30 Calendar Annual table configuration parameters

See F23 - Annual table.

| Offset | Field |
|---|---|
| +0 - +192 | Annual table 1 |
| +0 | Annual table 1 year F23N1 |
| +1 - +2 | Annual table 1 definition 1 F23N2 |
| +3 - +4 | Annual table 1 definition 2 F23N3 |
| ... | ... *etc* ... |
| +193 - +385 | Annual table 2 |
| ... | ... *etc* ... |
| +1930 - +2122 | Annual table 11 |

Each annual table starts with one byte defining the year and then 96 entries of year date definitions as follows:

| Offset | | Field |
|---|---|---|
| +0 | Function F23N2 | |
| +1 | MSB: | Month F23N2 |
| | LSB: | Day in month F23N2 |

1.2.5.31 Calendar Timetable Actions configuration parameters

In this table 8×16 Timetable plans (F46) are available, each occupying one register exactly.



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1.2.6 Writeable registers description

1.2.6.1 Current date and time

| Offset | | Field |
|---|---|---|
| +0 | MSB: | Year. |
| | | > 200 1750 will be added to value internally. |
| | | ≤ 200 2000 will be added to value internally. |
| | LSB: | Month (1-12) |
| +1 | MSB: | Day (1-31) |
| | LSB: | Hour (0-59) |
| +2 | MSB: | Minute (0-59) |
| | LSB: | Second (0-59) |

1.2.6.2 Current plan and situation

| Offset | | Field |
|---|---|---|
| +0 | MSB | Situation (0-16). |
| | LSB | Plan (1-32). |

1.2.6.3 Current plan cycle length and fixed time control

| Offset | | Field |
|---|---|---|
| +0 | MSB | Fixed time control. |
| | 0 | No fixed time control. |
| | 1 | Fixed time control. |
| | 2 | LSB Cycle length (0-255). |

1.2.6.4 Control intersection (dark/flash)

| 0 | Offset | Field |
|---|---|---|
| +0 | LSB | Control mode. |
| | 1 | Normal operation. |
| | 2 | Flash. |
| | 3 | Dark. |

1.2.6.5 Digital outputs

Set digital outputs 1-128. The flags are arranged so LSB in the first register maches output 1. The bit states are as follows:

| Value | Meaning |
|---|---|
| 0 | Deactivate digital output. |
| 1 | Activate digital output. |



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1.2.6.6 Software flags Set software flags 1-1024.

Each register is able to modify up to 8 flags by utilizing a bit mask. Only values with an active mask bit set, will be set according to the value field.

| Offset | Meaning |
|---|---|
| MSB: | Mask for 8 flags. |
| LSB: | Value for 8 flags. |

Example:

By setting a value 0x0101 to holding register 10 will set software flag 1 to active, while setting 0x0100 to register 10 will clear the flag.

By setting a value 0x0102, will have the same result as bit 2 is not covered by the mask and will therefore be ignored. Instead bit 1 is 0 and will therefore still clear software flag 1.

1.2.6.7 Memory registers

Set memory registers 1-250. A memory register is 1 byte. Each 16 bit register contains two memory registers. The registers are arranged as follows

| Offset | | Field |
|---|---|---|
| +0 | LSB: | Memory register 1. |
| | MSB: | Memory register 2. |
| +1 | LSB: | Memory register 3. |
| | MSB: | Memory register 4. |
| ... | ... | *etc* |
| +95 | LSB: | Memory register 191. |
| | MSB: | Memory register 192. |

1.2.6.8 Force detector logics

Force the state of detector logics 1-352. The registers are arranged as follows:

| Offset | | Field |
|---|---|---|
| +0 | LSB: | Detector logic 1<br>0 No forcing. Normal state.<br>1 Force detector logic active.<br>2 Force detector logic inactive. |
| | MSB: | Detector logic 2 |
| +1 | LSB: | Detector logic 3 |
| | MSB: | Detector logic 4 |
| ... | ... | *etc* |
| +99 | LSB: | Detector logic 199 |
| | MSB: | Detector logic 200 |



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#### 1.2.6.9 Control block parameters

Set control block parameters 1-240, from configuration F15N9-F15N248. Each control block parameter is 1 byte. Each register contains two control block parameters arranged like so:

| Offset | | Field |
|---|---|---|
| +0 | LSB: | Control block parameter 1. |
| | MSB: | Control block parameter 2. |
| +1 | LSB: | Control block parameter 3. |
| | MSB: | Control block parameter 4. |
| ... | ... | *etc* ... |
| +119 | LSB: | Control block parameter 239. |
| | MSB: | Control block parameter 240. |

#### 1.2.6.10 Traffic Plan parameters

Set plan parameters. (F36)

Each set of 124 registers contains the 248 plan parameters for a single plan. Each register contains two plan parameters.

The layout is as follows:

| Offset | Field |
|---|---|
| +0 - +123 | 248 plan parameters for plan 1. |
| +124 - +243 | 248 plan parameters for plan 2. |
| ... | ... *etc* ... |
| +3844 - +3967 | 248 plan parameters for plan 32. |

The individual plan registers are organized as follows:

| Offset | | Plan register |
|---|---|---|
| +0 | | Plan *X* parameters 1 & 2 |
| | LSB | Parameter 1 |
| | MSB | Parameter 2 |
| +1 | | Plan *X* parameters 3 & 4 |
| | LSB | Parameter 3 |
| | MSB | |
| | Parameter 4 ... | |
| | ... | ... *etc* ... |

#### 1.2.6.11 Traffic plan configuration parameters

| Offset | Group |
|---|---|
| +0 - +4 | Traffic plan 1 |
| +5 - +9 | Traffic plan 2 |
| ... | ... *etc* ... |
| +155 - +159 | Traffic plan 32 |



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A single plan uses the following registers

| Offset | | Field |
|---|---|---|
| +0 | | Plan type F03PN1 |
| +1 | MSB: | Start-up stage F03PN2 |
| | LSB: | Rest stage F03PN2 |
| +2 | | Shutdown stage F03PN2 |
| +3 | LSB: | Plan cycle F03PN10 |
| +4 | MSB: | Cycle offset F03PN11 |

### 1.2.6.12 Traffic plan group configuration parameters

| Address | Group |
|---|---|
| +0 - +383 | Traffic plan 1 |
| +0 - +3 | Traffic plan 1 - Group 1 |
| +4 - +7 | Traffic plan 1 - Group 2 |
| ... | ... *etc* ... |
| +384 - +768 | Traffic plan 2 |
| ... | ... *etc* ... |
| +11904 - +12287 | Traffic plan 32 |

The plan.group scheme is organized as follows:

| Offset | | Field |
|---|---|---|
| +0 | MSB | Max. min. green (1 sec) F07PGN1 |
| | LSB | Max. green (1 sec) F07PGN2 |
| +1 | MSB | Aux time (0.1 sec) F07PGN3 |
| | LSB | Var P-E-G time (0.1 sec) F07PGN4 |
| +2 | MSB | Privelege time (1 sec) F07PGN5 |
| | LSB | Start/stop order mode F07PGN6 |
| +3 | MSB | Sequence logic F07PGN7 |
| | LSB | Stage logic F07PGN8 |

### 1.2.6.13 Group configuration parameters

| Address | Group |
|---|---|
| +0 - +2 | Group 1 |
| +3 - +5 | Group 2 |
| ... | ... *etc* ... |
| +285 - +287 | Group 96 |

A single group uses the following registers

| Offset | | Field |
|---|---|---|
| +0 | MSB: | Red/Yellow (x0.1 secs) F04GN8 |
| | LSB | Min green (x0.1 secs) F04GN9 |
| +1 | MSB: | Green flash(x0.1 secs) F04GN10 |
| | LSB: | Min Yellow (0.1 secs) F04GN11 |
| +2 | MSB: | Var Yellow (0.1 secs) F04GN12 |
| | LSB: | Min Red (0.1 secs) F04GN13 |



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### 1.2.6.14 Stage logic group configuration parameters

A max of 16 stage logics are programmable. A read from undefined values will yield zero in all cases.

| Address | Group |
|---|---|
| +0 - +383 | Stage logic 1 |
| +0 - +3 | Stage logic 1 - Group 1 |
| +4 - +7 | Stage logic 1 - Group 2 |
| ... | ... *etc* ... |
| +384 - +767 | Stage logic 2 |
| ... | ... *etc* ... |
| +5760 - +6143 | Stage logic 16 |

The Logic.group scheme is organized as follows:

| Offset | Field |
|---|---|
| +0 | MSB: Req stages F009GN1 LSB: Primary stages F009GN2 |
| +1 | LSB: No-Req stages F009GN3 |

### 1.2.6.15 Calendar General configuration parameters

| Offset | Field |
|---|---|
| +0 | LSB: Daylight saving F21N2 |
| +1 | MSB: Daylight-saving-time begin x F21N3 LSB: Daylight-saving-time begin y |
| +2 | LSB Daylight-saving-time begin z |
| +3 | MSB: Daylight-saving-time end x F21N4 |
| | LSB: Daylight-saving-time end y |
| +4 | LSB: Daylight-saving-time end z |
| +5 | LSB: Long saturday F21N5 |
| | MSB: Special days interval definition. F21N14 |
| +6 - +70 | Set of Day set 1-32 F21N6 *(See below)* |

The Day set scheme is organized as follows per day set:

| Offset | Field |
|---|---|
| +0 | MSB: Day set X value |
| | LSB: Day set X value |
| +1 | LSB: Day set Z value |

### 1.2.6.16 Calendar Timetable configuration parameters

The maximum calendar timetable is a 32×32 table and is organized as follows:

| Offset | Field |
|---|---|
| +0 - +95 | Time table 1 |
| +96 - +191 | Time table 2 |
| ... | ... *etc* ... |
| +2976 - +3071 | Time table 32 |



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Each table defines a function (see F022TN1), repeated 32 times for each table.

| Offset | | Field |
|---|---|---|
| +0 | | Function. |
| +1 | | Hour |
| +2 | MSB: | Minute |
| | LSB: | Seconds |

1.2.6.17 Calendar Annual table configuration parameters

See F023 - Annual table.

| Offset | Field |
|---|---|
| +0 - +191 | Annual table 1 |
| +0 | Annual table 1 year F23N1 |
| +1 - +2 | Annual table 1 definition 1 F23N2 |
| +3 - +4 | Annual table 1 definition 2 F23N3 |
| ... | ... *etc* ... |
| +192 - +383 | Annual table 2 |
| ... | ... *etc* ... |
| +1920 - +2111 | Annual table 11 |

Each annual table starts with one byte defining the year and then 32 entries of year date definitions as follows:

| Offset | | Field |
|---|---|---|
| +0 | Function F23N2 +1 | |
| | MSB: | Month F23N2 |
| LSB: | Day in month F23N2 | |

1.2.6.18 Calendar Timetable Actions configuration parameters

In this table 8×16 Timetable plans are available, each occupying one register exactly.

See F046 - Timetable actions



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