

ENGINEERING
TOMORROW



Application guidelines

Variable speed scroll compressors **VSH088-117-170**

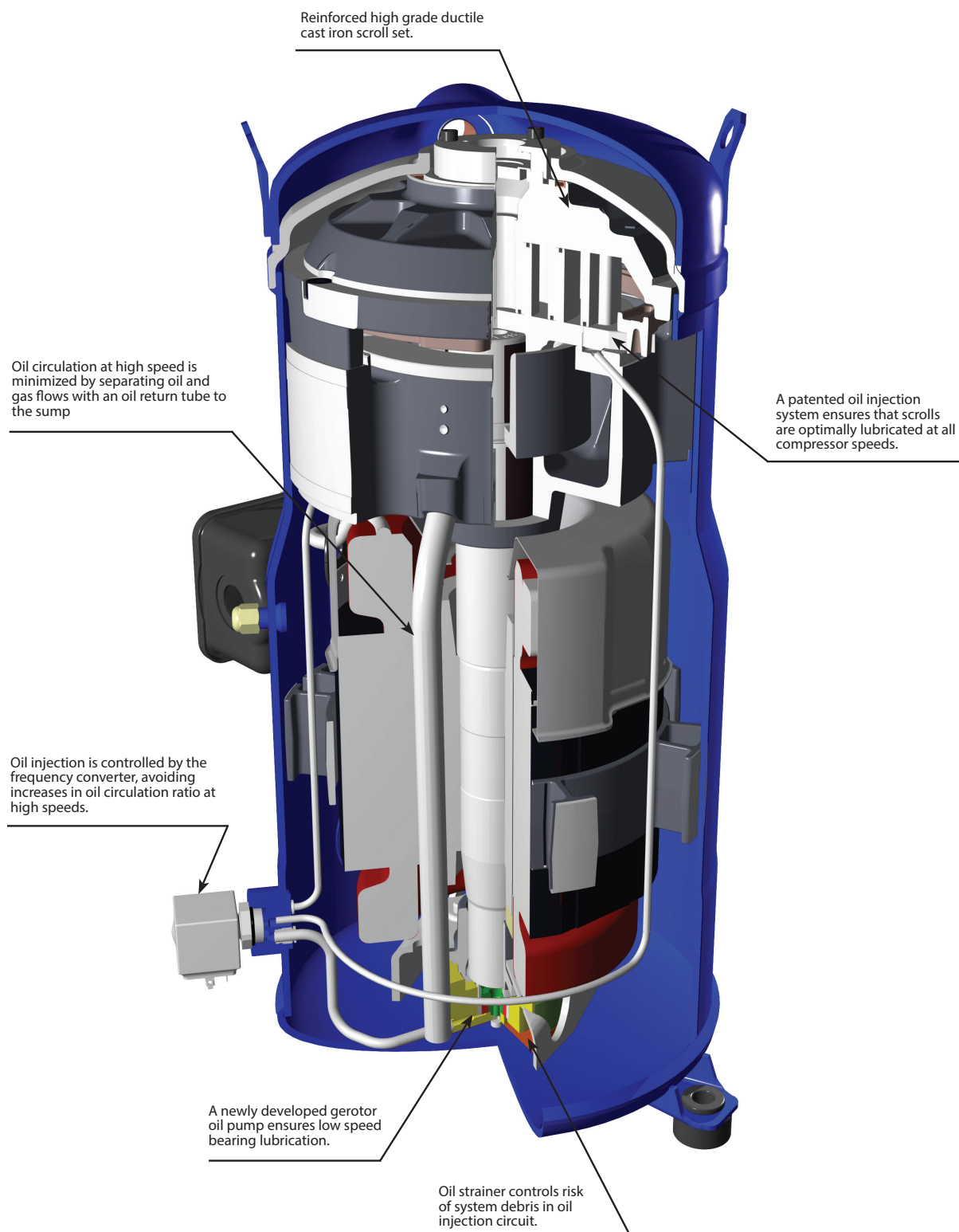
50 - 60 Hz - R410A



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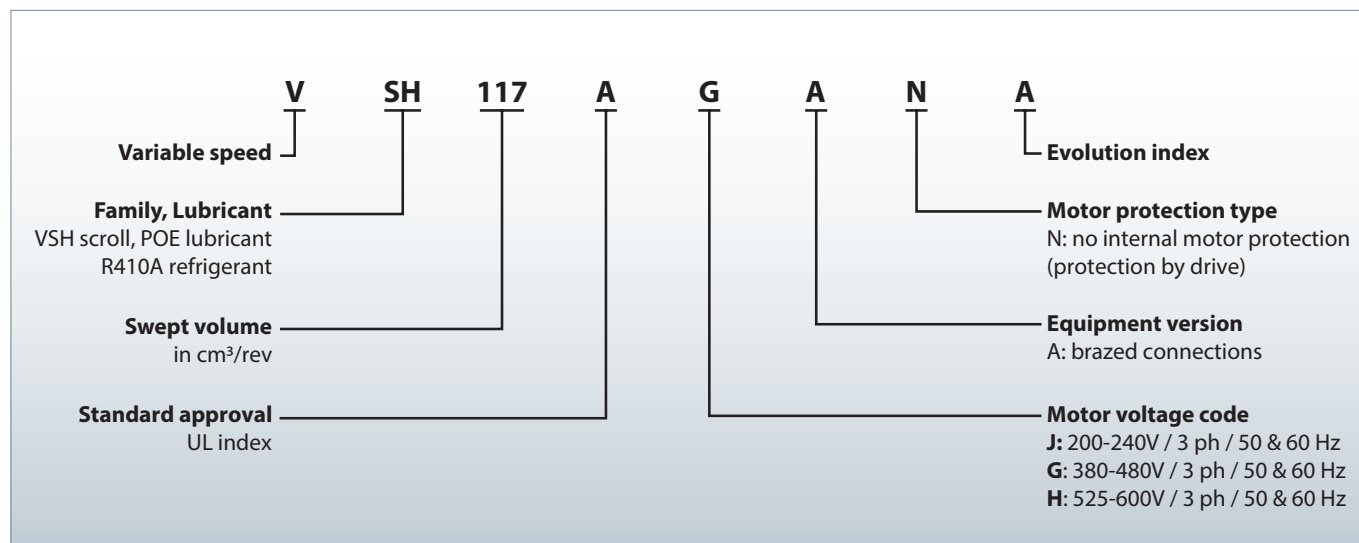
| | |
|--|-----------|
| VSH scroll specificities..... | 6 |
| Variable speed compressors..... | 7 |
| Compressor size | 7 |
| Frequency converter variants | 7 |
| Compressor and frequency converter combinations | 7 |
| Nomenclature and specifications..... | 8 |
| Compressor nomenclature | 8 |
| Frequency converter nomenclature..... | 8 |
| Technical specifications | 9 |
| Compressor specifications | 9 |
| Frequency converter specifications | 9 |
| Oil injection control..... | 9 |
| Bearings lubrication | 9 |
| Capacity at EN12900 rating conditions | 10 |
| Capacity at ARI rating conditions | 11 |
| Dimensions | 12 |
| VSH088-G & H..... | 12 |
| VSH088-J..... | 13 |
| VSH117-G & H..... | 14 |
| VSH117-J..... | 15 |
| VSH170- G - H & J..... | 16 |
| Sight glass | 17 |
| Schrader..... | 17 |
| Oil equalisation connection..... | 17 |
| Oil drain fitting | 17 |
| Suction & discharge connections | 17 |
| Frequency converter dimensions..... | 17 |
| CDS302 frequency converter - enclosure B1..... | 18 |
| CDS302 frequency converter - enclosure B2..... | 19 |
| CDS302 frequency converter - enclosure B3..... | 20 |
| CDS302 frequency converter - enclosure B4..... | 21 |
| CDS302 frequency converter - enclosure C1..... | 22 |
| CDS302 frequency converter - enclosure C3..... | 23 |
| Electrical data, connections and wiring..... | 24 |
| Supply voltage..... | 24 |
| Compressor electrical specifications..... | 24 |
| Fuses..... | 24 |
| Wire sizes | 25 |
| Wiring & EMC protection | 25 |
| Hipot test procedure | 26 |
| EMC correct installation of an IP20 frequency drive CDS302 | 27 |
| Wiring diagram..... | 28 |
| Wiring connections..... | 29 |
| Electrical connections..... | 30 |
| Soft-start control..... | 30 |
| Phase sequency and reverse rotation protection..... | 30 |
| IP rating | 31 |
| Motor protection | 31 |
| Voltage imbalance | 31 |
| Frequency converter efficiency..... | 31 |
| Ambient temperature and altitude..... | 31 |
| Approvals and certificates | 32 |
| Approvals and certificates..... | 32 |
| Pressure equipment directive 97/23/EC | 32 |
| Internal free volume | 32 |

| | |
|---|-----------|
| Operating conditions | 33 |
| Application envelope..... | 33 |
| Short cycle timer function..... | 33 |
| Discharge gas temperature protection function | 33 |
| Discharge gas thermostat | 34 |
| Oil return management function | 34 |
| High and low pressure protection..... | 35 |
| System design recommendations | 35 |
| Essential piping design considerations | 36 |
| Heat exchangers | 37 |
| Refrigerant charge limits | 37 |
| Off-cycle migration | 37 |
| Liquid floodback during operation..... | 38 |
| Specific application recommendations | 39 |
| Low ambient compressor operations | 39 |
| Braze plate heat exchangers..... | 40 |
| Reversible heat pump systems..... | 40 |
| Discharge line and reversing valve | 41 |
| Sound and vibration management..... | 42 |
| Running sound level | 42 |
| Sound generation in a refrigeration or air conditioning system..... | 42 |
| Compressor sound radiation..... | 42 |
| Mechanical vibrations..... | 42 |
| Speed by-pass..... | 42 |
| Gas pulsation | 42 |
| Installation | 43 |
| Compressor handling | 43 |
| Mounting..... | 43 |
| Removing connections shipping plugs | 43 |
| System cleanliness | 44 |
| Tubing..... | 44 |
| Filter driers | 44 |
| Brazing and soldering..... | 44 |
| Compressor connection..... | 44 |
| System pressure test | 45 |
| Leak detection | 45 |
| Vacuum pump down and moisture removal | 46 |
| Refrigerant charging | 46 |
| Commissioning | 47 |
| Oil level checking and top-up..... | 47 |
| Ordering information and packaging..... | 48 |
| Kit ordering and shipping | 48 |
| Packaging..... | 48 |
| VSH voltage code J - 200-240 Volt | 49 |
| VSH voltage code G - 380-480 Volt | 50 |
| VSH voltage code H - 525-600 Volt | 51 |
| Accessories | 48 |
| Valves, adapters, connectors & gaskets for use on suction and discharge connections | 52 |
| Crankcase heaters & thermostats | 53 |
| Lubricant , acoustic hoods and spareparts | 54 |
| Spare parts frequency converter | 55 |

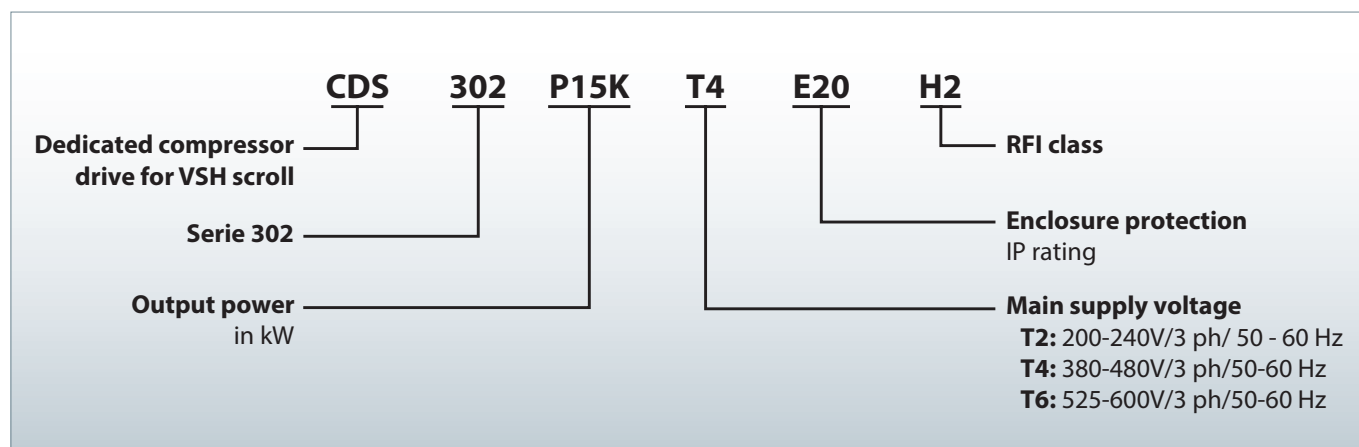


| Application guidelines | Variable speed compressors | |
|--|---|--|
| Compressor size | <p>Variable speed technology offers more flexibility in compressor selection than fixed speed compressors. Selection of the right variable speed compressor size can be done by different methods:</p> <ol style="list-style-type: none"> 1. Maximum cooling capacity: Select a compressor size which achieves the peak load system cooling capacity demand at its maximum speed. 2. Nominal cooling capacity: Select a compressor size which achieves the nominal system cooling capacity at a rotational speed of 3600 - 4500 rpm (60-75 Hz). | <p>3. Best Seasonal Efficiency Ratio: Select a compressor size which achieves the minimum system cooling demand at its minimum speed. Ensure that the compressor is able to cover the peak load system cooling capacity. This selection makes the compressor to run for a maximum of time at part load where the system efficiency is highest.</p> <p>Performance tables at 3 speeds can be found in following pages. Detailed performances can be found in datasheets and in selection program.</p> |
| Frequency converter variants | <p>Different frequency converter variants are available according to:</p> <p>Main supply voltage</p> <p>IP class (CDS302 drives are available in IP20 or IP55 housings)</p> | <p>3. RFI class (Radio Frequency Interference) H2 or H3</p> <p>4. Local Control Panel (LCP) provided or not</p> <p>5. Printed Circuit Board (PCB) coated or not coated.</p> |
| Compressor and frequency converter combinations | <p>When the compressor size and mains voltage have been defined with above selection criteria, the code number tables from section "Ordering information and packaging" give the appropriate</p> | <p>frequency converter sizes and up to 16 corresponding code numbers for each compressor model.</p> |

Compressor nomenclature



Frequency converter nomenclature



Application guidelines

Technical specifications

Compressor specifications

| Compressor model | Swept volume (in ³ /rev) | Displacement | | | | Oil charge (oz) | Net weight (lbs) |
|------------------|-------------------------------------|--------------------------------|----------------------------|----------------------------|--------------------------------|-----------------|------------------|
| | | Min speed (ft ³ /h) | 50 Hz (ft ³ /h) | 60 Hz (ft ³ /h) | Max speed (ft ³ /h) | | |
| VSH088 | 5.39 | 328 | 544 | 657 | 982 | 102 | 130 |
| VSH117 | 7.13 | 434 | 717 | 869 | 1292 | 112 | 143 |
| VSH170 | 10.39 | 629 | 1045 | 1261 | 1882 | 228 | 236 |

Frequency converter specifications

| | |
|----------------------|---|
| Mains supply voltage | T2: 200 - 240 V +/-10% (3-phase) |
| | T4: 380 - 480 V +/-10% (3-phase) |
| | T6: 525 - 600 V +/-10% (3-phase) |
| Supply frequency | 50 / 60 Hz |
| Output voltage | 0 - 100 % of supply voltage |
| Inputs | 6 digital (0 - 24 V), 2 analogue (-10 / +10 V or 0 / 4 V -20 mA, scalable) |
| Programmable outputs | 2 digital (0- 24 V), 1 analogue (0-24 V), 2 relay |
| Protection functions | Over-current protection, over-modulation handling, low / high current handling |
| Compressor functions | Discharge gas temperature protection, pressostat / thermostat function, short cycle protection, oil return management |

Oil injection control

VSH compressors are equipped with an oil injection system that ensures the scroll set lubrication and controls the oil circulation ratio, at all running speeds. The frequency converter via an oil injection valve controls this system. The oil injection valve is a normally closed valve. At low speed, the valve is closed and the oil is injected below the orbiting scroll.

The compressors are delivered with 230V coils. 24V coils are available as accessory (see accessories page at the end of this document).

Control parameters are factory preset but accessible on the parameter list as read only values.

Bearings lubrication

Optimal bearings lubrication is ensured by a gerotor oil pump at all compressor speeds.

Application guidelines Technical specifications

Capacity at EN12900 rating conditions

| Model | | To | -10 | | 0 | | 10 | | 20 | | 30 | | 40 | | 50 | |
|--------|----------|-----|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| | | Tc | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe |
| VSH088 | 1800 rpm | 70 | - | - | 23,000 | 2.31 | 28,800 | 2.31 | 35,800 | 2.28 | 44,100 | 2.23 | 53,800 | 2.15 | - | - |
| | | 90 | - | - | 20,200 | 2.96 | 25,800 | 2.97 | 32,300 | 2.97 | 40,100 | 2.95 | 49,100 | 2.91 | 59,500 | 2.84 |
| | | 110 | - | - | - | - | 21,700 | 3.80 | 27,500 | 3.80 | 34,400 | 3.79 | 42,400 | 3.78 | 51,700 | 3.74 |
| | | 130 | - | - | - | - | - | - | - | - | 27,400 | 4.98 | 34,100 | 4.96 | 42,000 | 4.93 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3600 rpm | 70 | 39,100 | 4.44 | 49,100 | 4.52 | 61,200 | 4.59 | 75,700 | 4.64 | 92,800 | 4.66 | 112,700 | 4.65 | - | - |
| | | 90 | 33,700 | 5.60 | 43,200 | 5.66 | 54,500 | 5.74 | 67,800 | 5.82 | 83,500 | 5.89 | 101,700 | 5.94 | 122,600 | 5.96 |
| | | 110 | - | - | - | - | 47,300 | 7.12 | 59,200 | 7.20 | 73,200 | 7.30 | 89,300 | 7.40 | 108,000 | 7.48 |
| | | 130 | - | - | - | - | - | - | - | - | 61,200 | 9.12 | 75,000 | 9.23 | 91,000 | 9.36 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 71,100 | 11.81 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 66,700 | 12.39 |
| | 5400 rpm | 70 | 58,800 | 6.12 | 73,500 | 6.32 | 91,400 | 6.47 | 112,800 | 6.58 | 138,100 | 6.65 | 167,800 | 6.69 | - | - |
| | | 90 | 51,000 | 8.49 | 65,100 | 8.74 | 81,900 | 8.95 | 101,900 | 9.12 | 125,400 | 9.26 | 152,800 | 9.38 | 184,500 | 9.48 |
| | | 110 | - | - | - | - | 71,400 | 10.95 | 89,300 | 11.19 | 110,300 | 11.40 | 134,900 | 11.59 | 163,400 | 11.78 |
| | | 130 | - | - | - | - | - | - | - | - | 92,400 | 13.83 | 113,500 | 14.10 | 138,100 | 14.37 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 108,000 | 18.01 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 101,300 | 18.93 |
| VSH117 | 1800 rpm | 70 | - | - | 26,600 | 2.93 | 34,500 | 2.95 | 44,200 | 2.95 | 55,600 | 2.94 | 69,000 | 2.94 | - | - |
| | | 90 | - | - | 24,500 | 3.83 | 32,200 | 3.86 | 41,200 | 3.87 | 51,700 | 3.87 | 64,000 | 3.88 | 78,100 | 3.91 |
| | | 110 | - | - | - | - | 28,100 | 4.97 | 36,100 | 4.97 | 45,400 | 4.97 | 56,200 | 4.98 | 68,600 | 5.01 |
| | | 130 | - | - | - | - | - | - | - | - | 37,000 | 6.44 | 45,900 | 6.43 | 56,100 | 6.45 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3600 rpm | 70 | 54,300 | 5.97 | 68,200 | 6.09 | 85,000 | 6.24 | 105,000 | 6.39 | 128,500 | 6.56 | 155,900 | 6.71 | - | - |
| | | 90 | 45,100 | 7.38 | 57,900 | 7.48 | 73,100 | 7.61 | 91,100 | 7.79 | 112,300 | 7.99 | 137,000 | 8.21 | 165,500 | 8.44 |
| | | 110 | - | - | - | - | 62,400 | 9.36 | 78,300 | 9.50 | 96,900 | 9.69 | 118,600 | 9.92 | 143,800 | 10.18 |
| | | 130 | - | - | - | - | - | - | - | - | 80,900 | 11.96 | 99,500 | 12.14 | 121,100 | 12.37 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 96,100 | 15.34 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 90,700 | 16.05 |
| | 5400 rpm | 70 | 78,000 | 8.82 | 98,100 | 9.21 | 122,400 | 9.67 | 151,500 | 10.13 | 185,900 | 10.57 | 226,100 | 10.93 | - | - |
| | | 90 | 66,900 | 11.02 | 86,000 | 11.31 | 108,700 | 11.72 | 135,600 | 12.20 | 167,200 | 12.72 | 204,000 | 13.23 | 246,600 | 13.67 |
| | | 110 | - | - | - | - | 94,500 | 14.07 | 118,500 | 14.47 | 146,700 | 14.97 | 179,500 | 15.52 | 217,600 | 16.07 |
| | | 130 | - | - | - | - | - | - | - | - | 123,100 | 17.82 | 151,300 | 18.31 | 184,100 | 18.87 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 145,000 | 22.58 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 136,300 | 23.47 |
| VSH170 | 1800 rpm | 70 | - | - | 37,500 | 4.22 | 51,800 | 4.24 | 68,700 | 4.23 | 88,200 | 4.15 | 110,400 | 3.95 | - | - |
| | | 90 | - | - | 30,400 | 5.60 | 43,200 | 5.62 | 58,100 | 5.65 | 75,100 | 5.67 | 94,200 | 5.63 | 115,500 | 5.49 |
| | | 110 | - | - | - | - | 35,200 | 7.35 | 48,500 | 7.35 | 63,300 | 7.38 | 79,900 | 7.41 | 98,000 | 7.40 |
| | | 130 | - | - | - | - | - | - | - | - | 50,800 | 9.71 | 65,100 | 9.72 | 80,700 | 9.75 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3600 rpm | 70 | 74,300 | 8.54 | 93,900 | 8.67 | 117,700 | 8.79 | 146,200 | 8.87 | 179,900 | 8.88 | 219,200 | 8.78 | - | - |
| | | 90 | 63,100 | 11.22 | 81,500 | 11.28 | 103,500 | 11.37 | 129,600 | 11.47 | 160,400 | 11.55 | 196,200 | 11.59 | 237,700 | 11.55 |
| | | 110 | - | - | - | - | 89,100 | 14.21 | 112,200 | 14.26 | 139,500 | 14.35 | 171,200 | 14.44 | 208,100 | 14.50 |
| | | 130 | - | - | - | - | - | - | - | - | 116,000 | 17.91 | 143,200 | 17.97 | 174,800 | 18.06 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 136,600 | 22.89 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 128,200 | 24.07 |
| | 5400 rpm | 70 | 114,500 | 13.12 | 144,000 | 13.45 | 179,600 | 13.81 | 222,100 | 14.16 | 272,000 | 14.48 | 330,200 | 14.72 | - | - |
| | | 90 | 98,300 | 16.82 | 126,200 | 17.05 | 159,300 | 17.36 | 198,300 | 17.71 | 243,900 | 18.07 | 296,800 | 18.41 | 357,800 | 18.70 |
| | | 110 | - | - | - | - | 138,800 | 21.24 | 173,700 | 21.52 | 214,300 | 21.86 | 261,400 | 22.22 | 315,500 | 22.59 |
| | | 130 | - | - | - | - | - | - | - | - | 180,700 | 26.62 | 221,100 | 26.93 | 267,800 | 27.30 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 212,100 | 33.61 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 199,700 | 35.14 |

To: Evaporating temperature in °F
Superheat: 18°F

Tc: Condensing temperature in °F
Subcooling: 0°F

Qo: Cooling capacity Btu/h
Pe: Power input in kW

Presented data are for models with motor voltage code G

Capacity at ARI rating conditions

| Model | | To | -10 | | 0 | | 10 | | 20 | | 30 | | 40 | | 50 | |
|--------|----------|-----|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| | | Tc | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe | Qo | Pe |
| VSH088 | 1800 rpm | 70 | - | - | 24 500 | 2.31 | 30 800 | 2.31 | 38 200 | 2.28 | 47 000 | 2.23 | 57 300 | 2.15 | - | - |
| | | 90 | - | - | 21 900 | 2.96 | 27 800 | 2.97 | 34 900 | 2.97 | 43 200 | 2.95 | 52 800 | 2.91 | 64 000 | 2.84 |
| | | 110 | - | - | - | - | 23 800 | 3.80 | 30 200 | 3.80 | 37 700 | 3.79 | 46 400 | 3.78 | 56 500 | 3.74 |
| | | 130 | - | - | - | - | - | - | - | - | 30 900 | 4.98 | 38 400 | 4.96 | 47 100 | 4.93 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3600 rpm | 70 | 41 800 | 4.44 | 52 500 | 4.52 | 65 400 | 4.59 | 80 800 | 4.64 | 98 900 | 4.66 | 120 000 | 4.65 | - | - |
| | | 90 | 36 500 | 5.60 | 46 700 | 5.66 | 58 900 | 5.74 | 73 200 | 5.82 | 90 000 | 5.89 | 109 500 | 5.94 | 131 900 | 5.96 |
| | | 110 | - | - | - | - | 52 000 | 7.12 | 65 000 | 7.20 | 80 200 | 7.30 | 97 700 | 7.40 | 118 000 | 7.48 |
| | | 130 | - | - | - | - | - | - | - | - | 68 800 | 9.12 | 84 300 | 9.23 | 102 100 | 9.36 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 85 000 | 11.81 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 81 600 | 12.39 |
| | 5400 rpm | 70 | 62 900 | 6.12 | 78 600 | 6.32 | 97 600 | 6.47 | 120 300 | 6.58 | 147 300 | 6.65 | 178 800 | 6.69 | - | - |
| | | 90 | 55 300 | 8.49 | 70 400 | 8.74 | 88 500 | 8.95 | 109 900 | 9.12 | 135 100 | 9.26 | 164 500 | 9.38 | 198 500 | 9.48 |
| | | 110 | - | - | - | - | 78 500 | 10.95 | 98 000 | 11.19 | 120 900 | 11.40 | 147 600 | 11.59 | 178 600 | 11.78 |
| | | 130 | - | - | - | - | - | - | - | - | 104 000 | 13.83 | 127 600 | 14.10 | 155 000 | 14.36 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 129 100 | 18.00 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 124 000 | 18.93 |
| VSH117 | 1800 rpm | 70 | - | - | 28 400 | 2.93 | 36 900 | 2.95 | 47 100 | 2.95 | 59 300 | 2.94 | 73 500 | 2.94 | - | - |
| | | 90 | - | - | 26 500 | 3.83 | 34 800 | 3.86 | 44 400 | 3.87 | 55 800 | 3.87 | 68 900 | 3.88 | 84 100 | 3.91 |
| | | 110 | - | - | - | - | 30 800 | 4.97 | 39 600 | 4.97 | 49 800 | 4.97 | 61 500 | 4.97 | 74 900 | 5.00 |
| | | 130 | - | - | - | - | - | - | - | - | 41 600 | 6.44 | 51 500 | 6.43 | 63 000 | 6.45 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3600 rpm | 70 | 58 100 | 5.97 | 72 900 | 6.09 | 90 800 | 6.24 | 112 000 | 6.39 | 137 000 | 6.55 | 166 100 | 6.71 | - | - |
| | | 90 | 48 800 | 7.38 | 62 600 | 7.48 | 79 000 | 7.61 | 98 300 | 7.79 | 121 000 | 7.99 | 147 500 | 8.21 | 178 000 | 8.44 |
| | | 110 | - | - | - | - | 68 500 | 9.36 | 86 800 | 9.50 | 106 100 | 9.69 | 129 800 | 9.92 | 157 100 | 10.18 |
| | | 130 | - | - | - | - | - | - | - | - | 91 100 | 11.96 | 111 800 | 12.14 | 135 900 | 12.37 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 114 900 | 15.34 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 111 100 | 16.05 |
| | 5400 rpm | 70 | 83 500 | 8.82 | 104 900 | 9.21 | 130 800 | 9.67 | 161 700 | 10.13 | 198 200 | 10.57 | 240 800 | 10.93 | - | - |
| | | 90 | 72 500 | 11.02 | 93 000 | 11.31 | 117 400 | 11.72 | 146 300 | 12.20 | 180 200 | 12.72 | 219 700 | 13.23 | 265 400 | 13.67 |
| | | 110 | - | - | - | - | 103 800 | 14.07 | 130 000 | 14.47 | 160 700 | 14.97 | 196 400 | 15.52 | 237 800 | 16.07 |
| | | 130 | - | - | - | - | - | - | - | - | 138 600 | 17.82 | 170 000 | 18.31 | 206 600 | 18.87 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 173 300 | 22.58 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 166 900 | 23.47 |
| VSH170 | 1800 rpm | 70 | - | - | 40 100 | 4.22 | 55 400 | 4.24 | 73 300 | 4.23 | 94 100 | 4.15 | 117 600 | 3.95 | - | - |
| | | 90 | - | - | 32 900 | 5.60 | 46 700 | 5.62 | 62 700 | 5.65 | 80 900 | 5.67 | 101 400 | 5.63 | 124 300 | 5.49 |
| | | 110 | - | - | - | - | 38 600 | 7.35 | 53 200 | 7.35 | 69 400 | 7.38 | 87 400 | 7.41 | 107 200 | 7.40 |
| | | 130 | - | - | - | - | - | - | - | - | 57 200 | 9.71 | 73 200 | 9.72 | 90 500 | 9.75 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3600 rpm | 70 | 79 500 | 8.54 | 100 400 | 8.67 | 125 700 | 8.79 | 156 000 | 8.87 | 191 800 | 8.88 | 233 500 | 8.78 | - | - |
| | | 90 | 68 300 | 11.22 | 88 100 | 11.28 | 111 800 | 11.37 | 139 900 | 11.47 | 172 900 | 11.55 | 211 300 | 11.59 | 255 700 | 11.55 |
| | | 110 | - | - | - | - | 97 800 | 14.21 | 123 100 | 14.26 | 152 800 | 14.35 | 187 400 | 14.43 | 227 400 | 14.50 |
| | | 130 | - | - | - | - | - | - | - | - | 130 600 | 17.91 | 160 900 | 17.97 | 196 100 | 18.06 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 163 200 | 22.89 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 156 900 | 24.07 |
| | 5400 rpm | 70 | 122 500 | 13.12 | 153 900 | 13.45 | 191 800 | 13.81 | 237 000 | 14.16 | 290 000 | 14.48 | 351 800 | 14.72 | - | - |
| | | 90 | 106 400 | 16.82 | 136 400 | 17.05 | 172 000 | 17.36 | 213 900 | 17.71 | 262 900 | 18.07 | 319 600 | 18.41 | 384 900 | 18.70 |
| | | 110 | - | - | - | - | 152 500 | 21.24 | 190 600 | 21.52 | 234 800 | 21.86 | 286 000 | 22.22 | 344 800 | 22.59 |
| | | 130 | - | - | - | - | - | - | - | - | 203 400 | 26.62 | 248 500 | 26.93 | 300 500 | 27.30 |
| | | 150 | - | - | - | - | - | - | - | - | - | - | - | - | 253 500 | 33.61 |
| | | 154 | - | - | - | - | - | - | - | - | - | - | - | - | 244 500 | 35.14 |

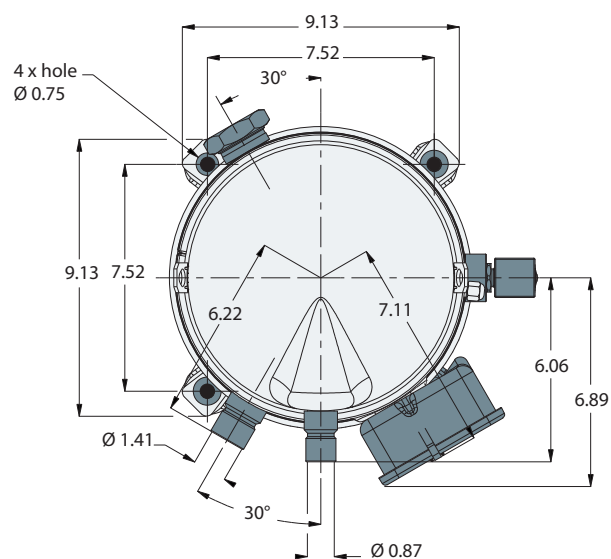
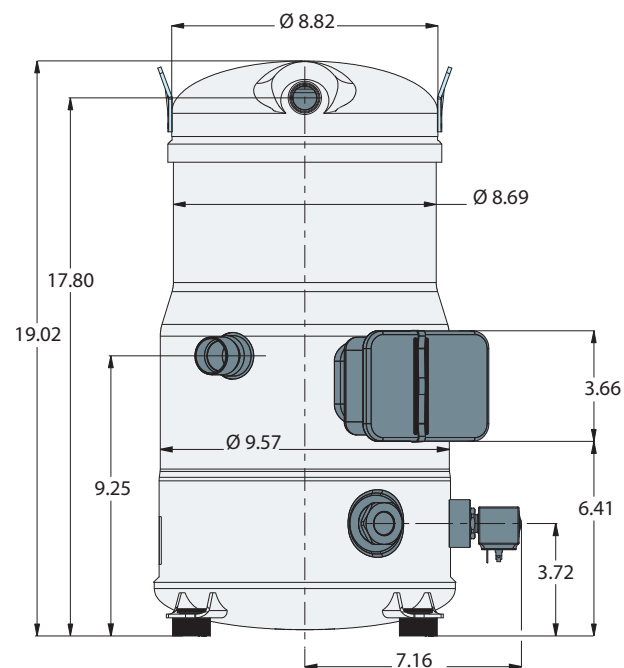
To: Evaporating temperature in °F
Superheat: 20°F

Tc: Condensing temperature in °F
Subcooling: 15°F

Qo: Cooling capacity Btu/h
Pe: Power input in kW

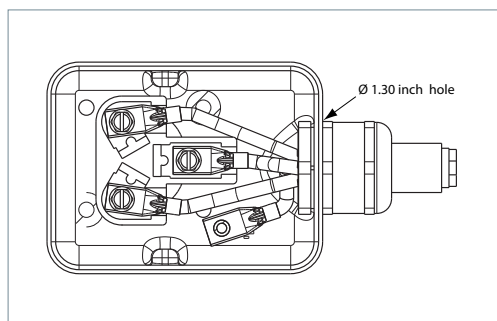
Presented data are for models with motor voltage code G

VSH088-G & H

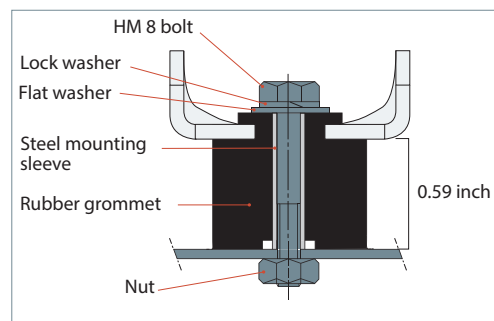


All dimensions in inch

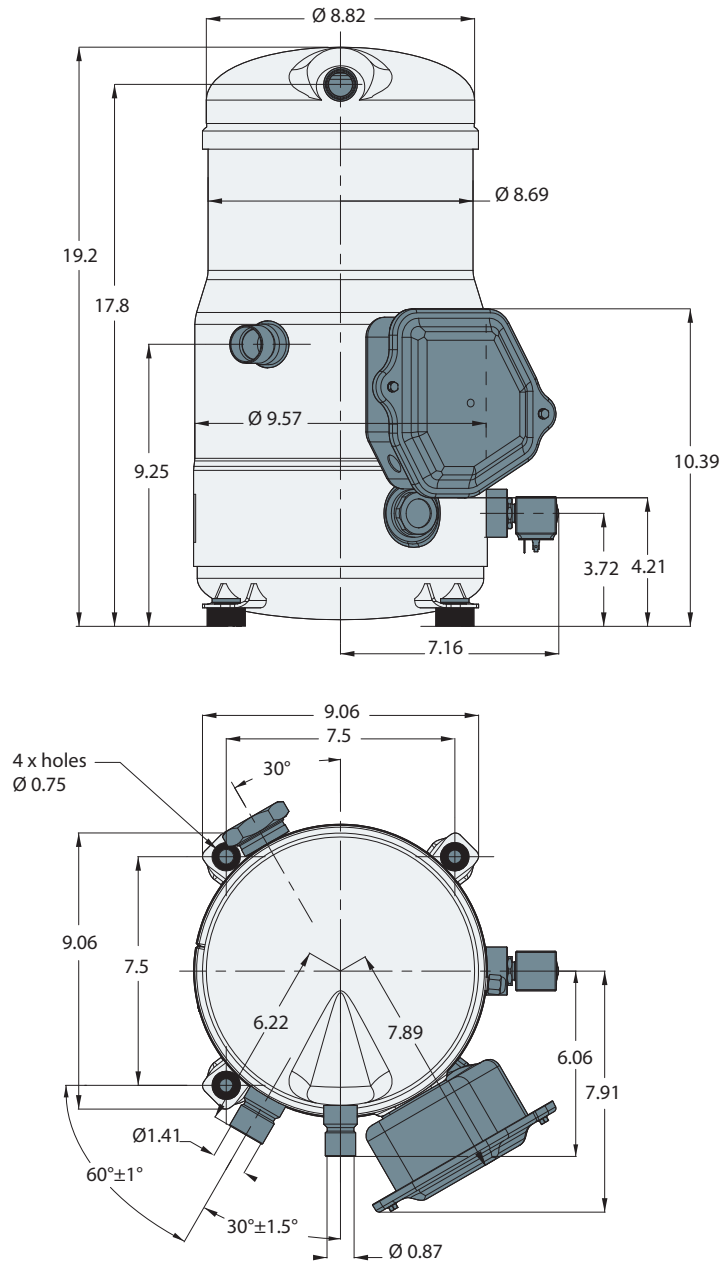
Electrical box



Grommet

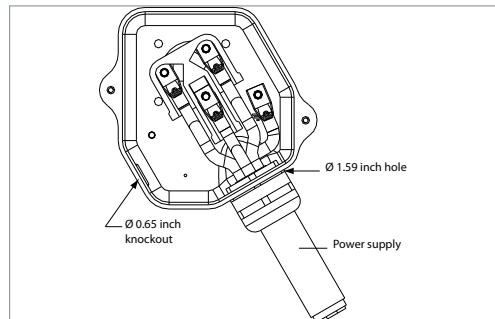


VSH088-J

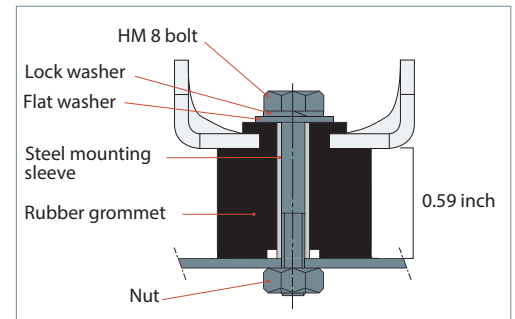


All dimensions in inch

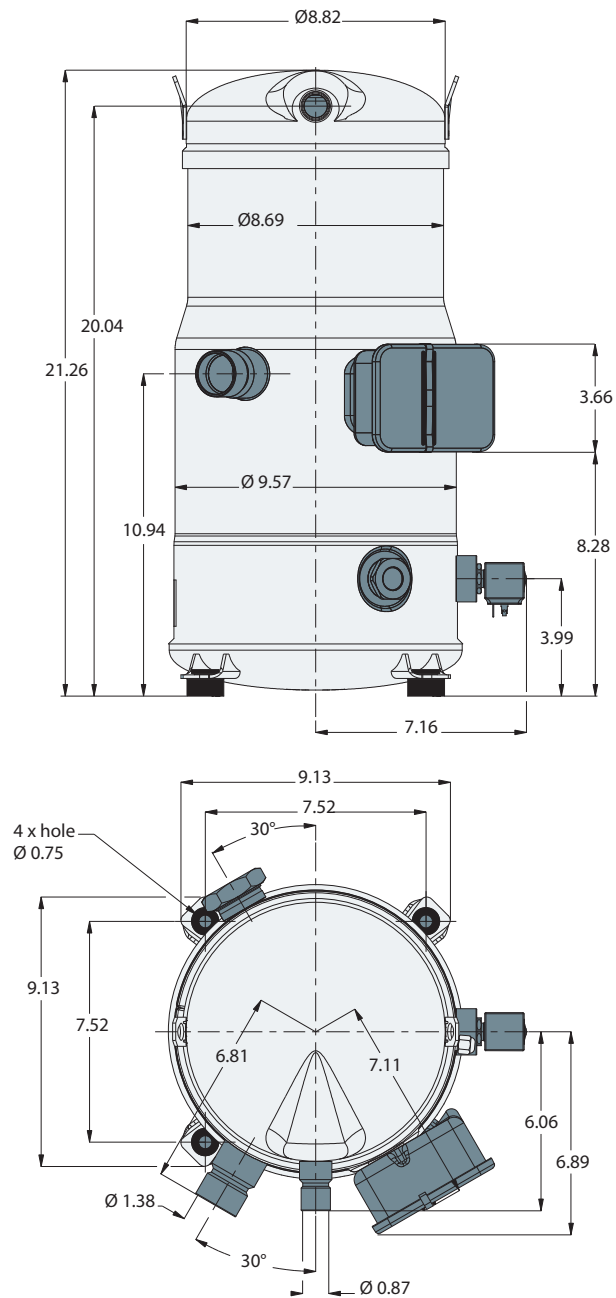
Electrical box



Grommet

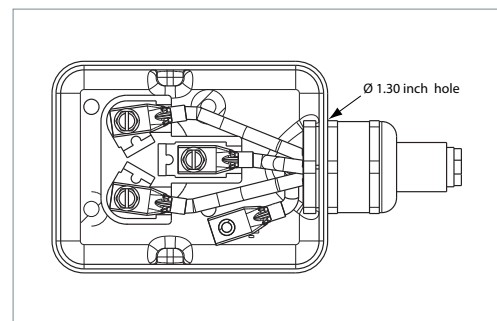


VSH117-G & H

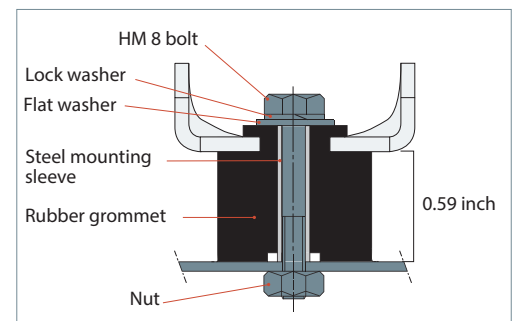


All dimensions in inch

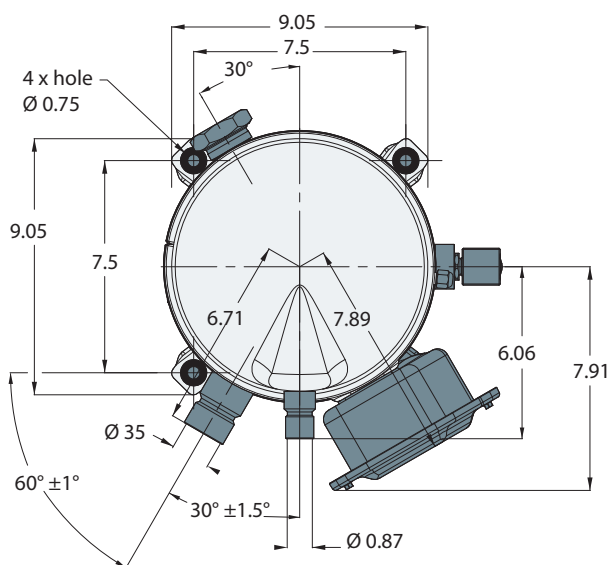
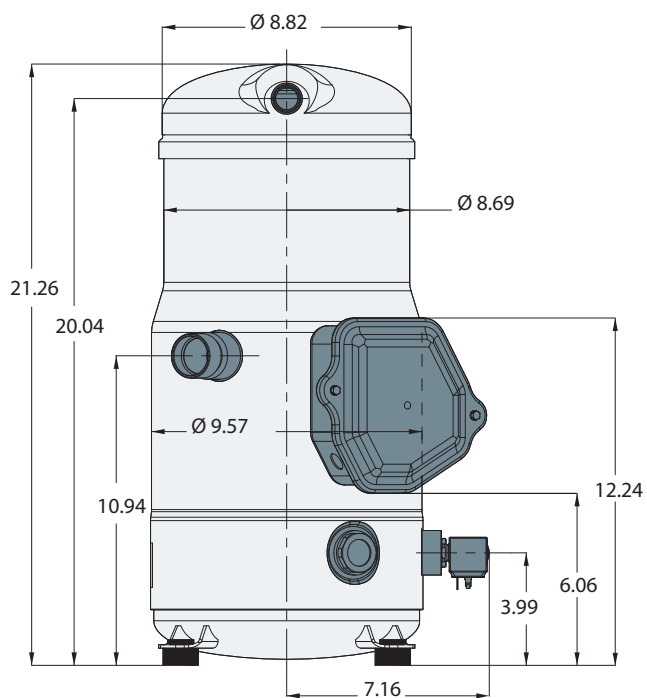
Electrical box



Grommet

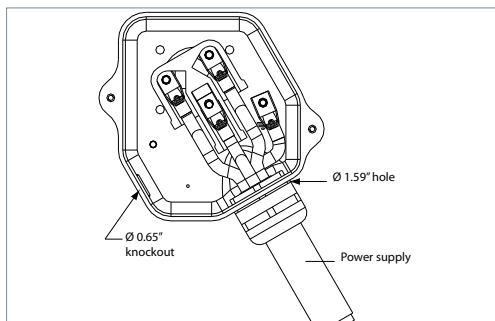


VSH117-J

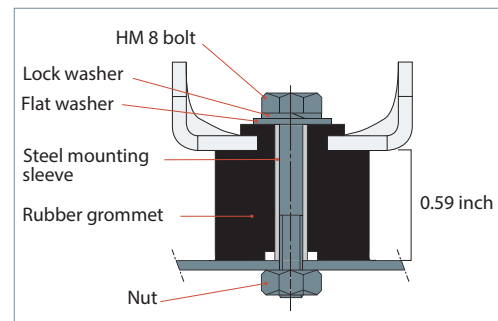


All dimensions in inch

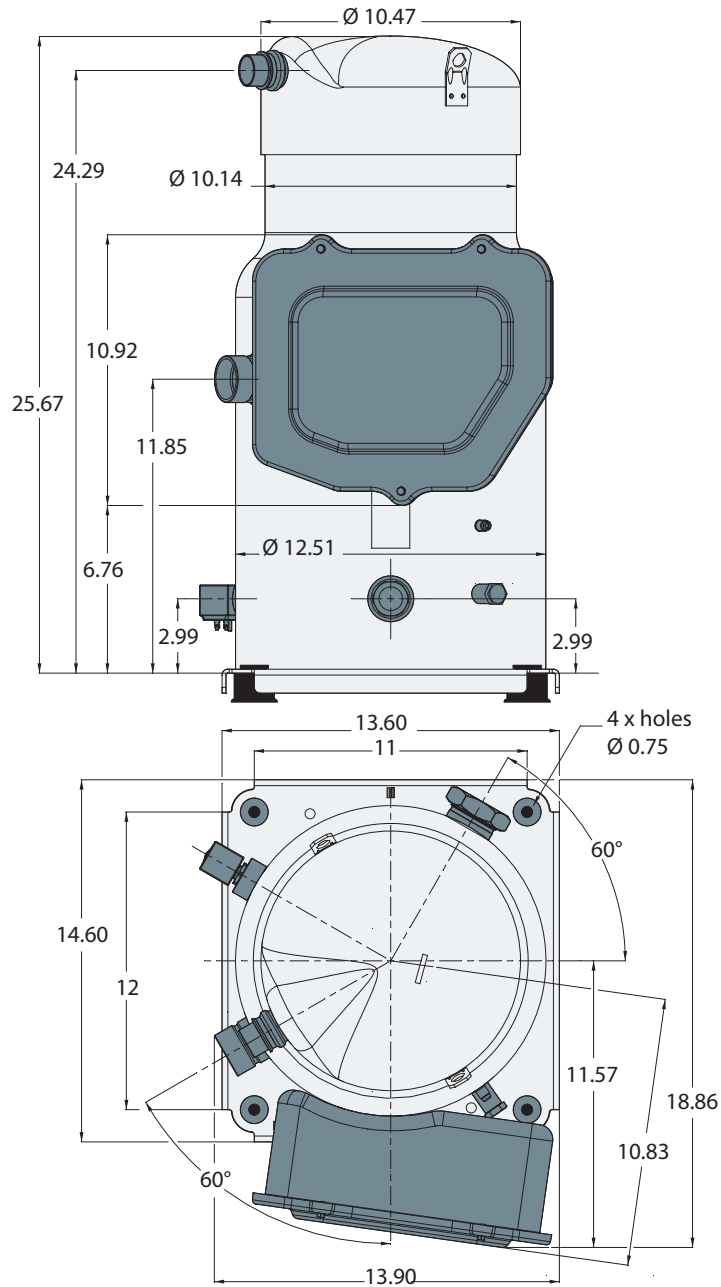
Electrical box



Grommet

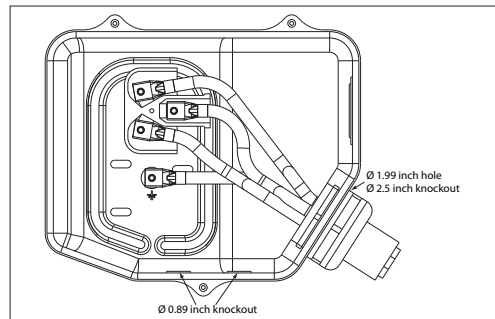


VSH170- G - H & J

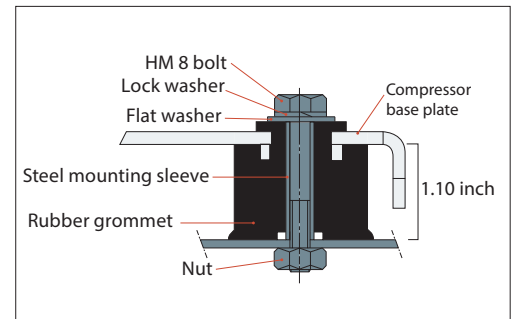


All dimensions in inch

Electrical box



Grommet



Application guidelines

Dimensions

Sight glass

VSH compressors come equipped with a threaded oil sight glass with 1"1/8 – 18 UNEF connection. It can be used for visual check of oil amount

and conditions, or it may be replaced by an oil management device.

Schrader

The oil fill connection and gauge port is a 1/4" male flare connector incorporating a schrader valve.

Oil equalisation connection

VSH compressors are equipped with rotolock oil equalisation connection. This connection is used when compressors are mounted in parallel. Contact Danfoss for further details.

| | Oil equalization |
|--------|------------------|
| VSH088 | Rotolock 1" 3/4 |
| VSH117 | Rotolock 1" 3/4 |
| VSH170 | Rotolock 2" 1/4 |

Oil drain fitting

VSH170 are equipped with oil drain connection. This connection is a female 1/4" NPTF fitting, which allows oil to be removed for testing, replacement etc...

This fitting contains an internal extension tube in order to collect the oil at the bottom of the oil sump.

VSH088 and VSH117 are not equipped with oil drain fitting.

Suction & discharge connections

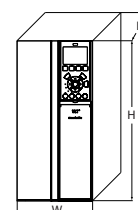
VSH compressors are all delivered with suction and discharge brazed connections only. They are copper plated steel connections.

Rotolock adaptors are available, refer to section "Accessories".

| | Suction | Discharge |
|--------|---------|-----------|
| VSH088 | 1" 1/8 | 7/8" |
| VSH117 | 1" 3/8 | 7/8" |
| VSH170 | 1" 5/8 | 1" 1/8 |

Frequency converter dimensions

Frequency converter dimensions depend on supply voltage, IP rating and power. The below table gives an overview of the overall dimensions and different drive enclosures (B1 - C3). Details for each drive enclosure are on the following pages.

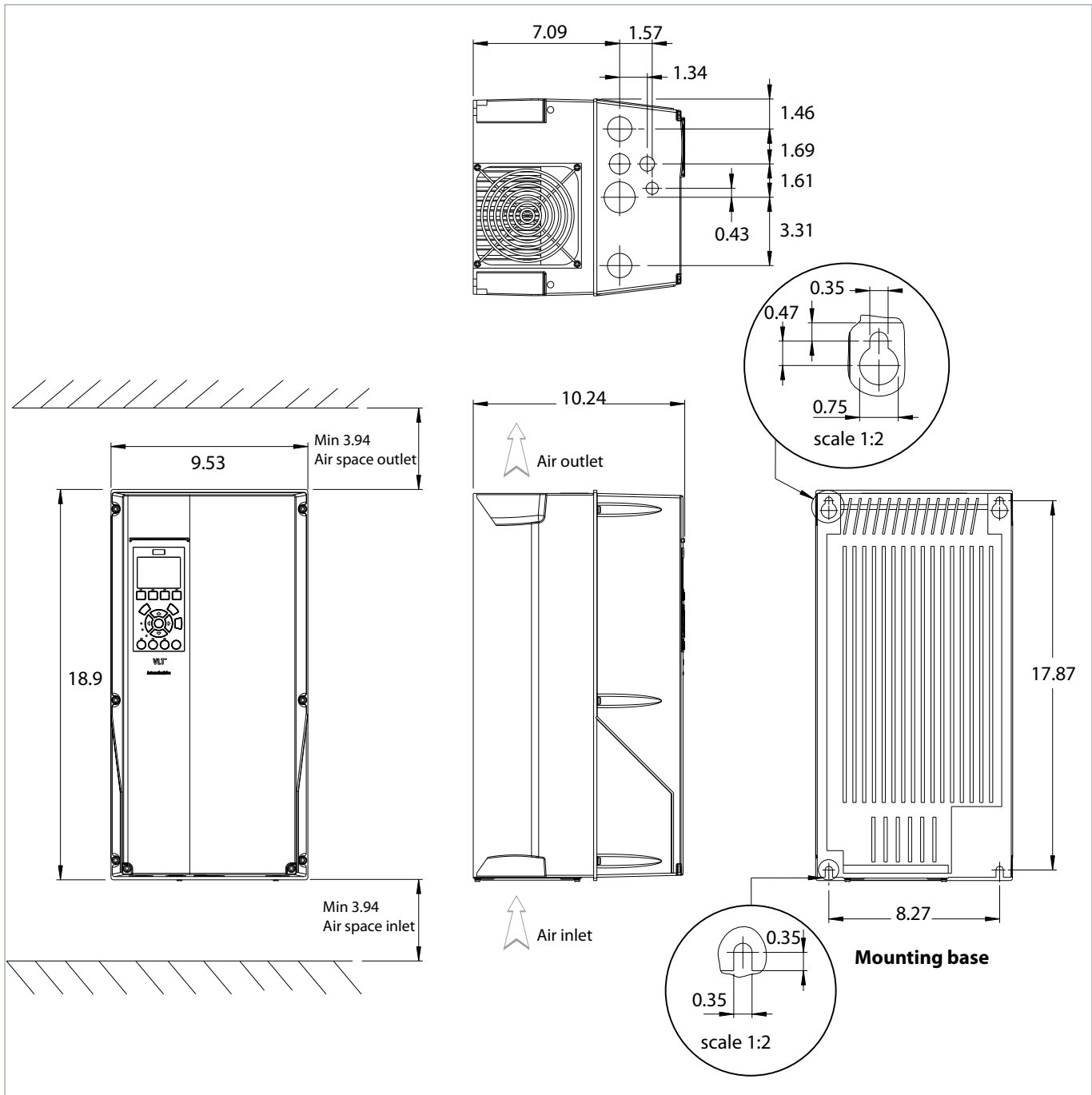


| Drive supply voltage | Drive power kW | Compressor voltage code | Compressor model | IP20 | | IP55 | |
|----------------------|----------------|-------------------------|------------------|-----------------|-------------------------------------|-----------------|-------------------------------------|
| | | | | Drive enclosure | Overall drive size (h x w x L) inch | Drive enclosure | Overall drive size (h x w x L) inch |
| T2: 200-240/3/50-60 | 15 | J | VSH088 | B4 | 23.43 x 9.09 x 9.53 | C1 | 26.77 x 12.13 x 12.20 |
| | 18.5 | | VSH117 | C3 | 24.80 x 12.13 x 13.15 | C1 | 26.77 x 12.13 x 12.20 |
| | 22 | | VSH170 | C3 | 24.80 x 12.13 x 13.15 | C1 | 26.77 x 12.13 x 12.20 |
| T4: 380-480/3/50-60 | 15 | G | VSH088 | B3 | 13.50 x 6.50 x 9.76 | B1 | 18.90 x 9.45 x 10.24 |
| | 18.5 | | VSH117 | B4 | 23.43 x 9.09 x 9.53 | B2 | 25.60 x 9.53 x 10.24 |
| | 22 | | VSH170 | B4 | 23.43 x 9.09 x 9.53 | B2 | 25.60 x 9.53 x 10.24 |
| T6: 525-600/3/50-60 | 15 | H | VSH088 | B3 | 13.50 x 6.50 x 9.76 | B1 | 18.90 x 9.45 x 10.24 |
| | 18.5 | | VSH117 | B4 | 23.43 x 9.09 x 9.53 | B2 | 25.60 x 9.53 x 10.24 |
| | 22 | | VSH170 | B4 | 23.43 x 9.09 x 9.53 | B2 | 25.60 x 9.53 x 10.24 |

CDS302 frequency converter - enclosure B1

380-480 Volts - 15 kW - IP55 housing

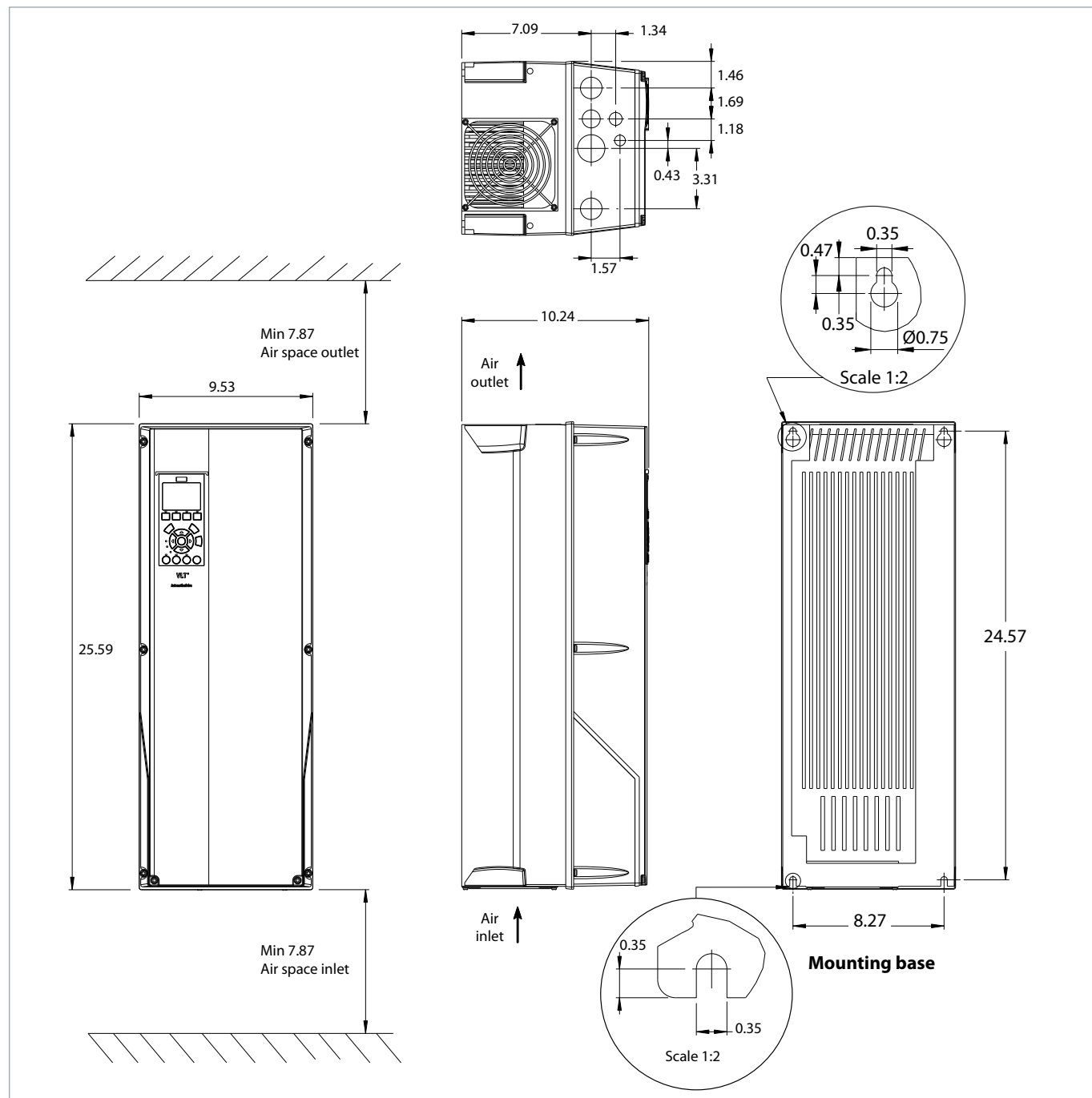
525-600 volts - 15 kW - IP55 housing



CDS302 frequency converter - enclosure B2

380-480 volts – 18-22 kW - IP55 housing

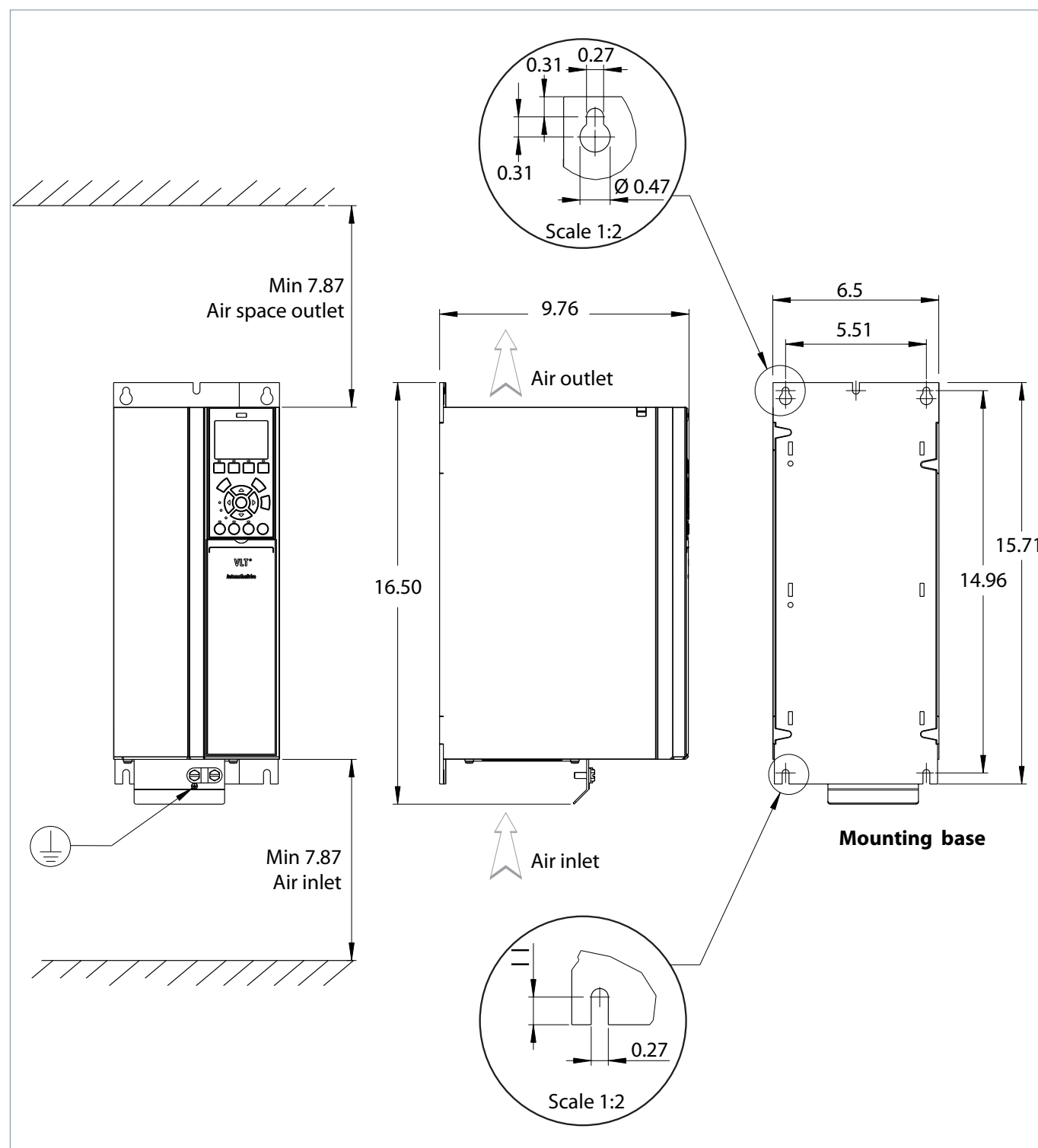
525-600 volts – 18-22 kW - IP55 housing



CDS302 frequency converter - enclosure B3

380-480 volts - 15 kW - IP20 housing

525-600 volts - 15 kW - IP20 housing

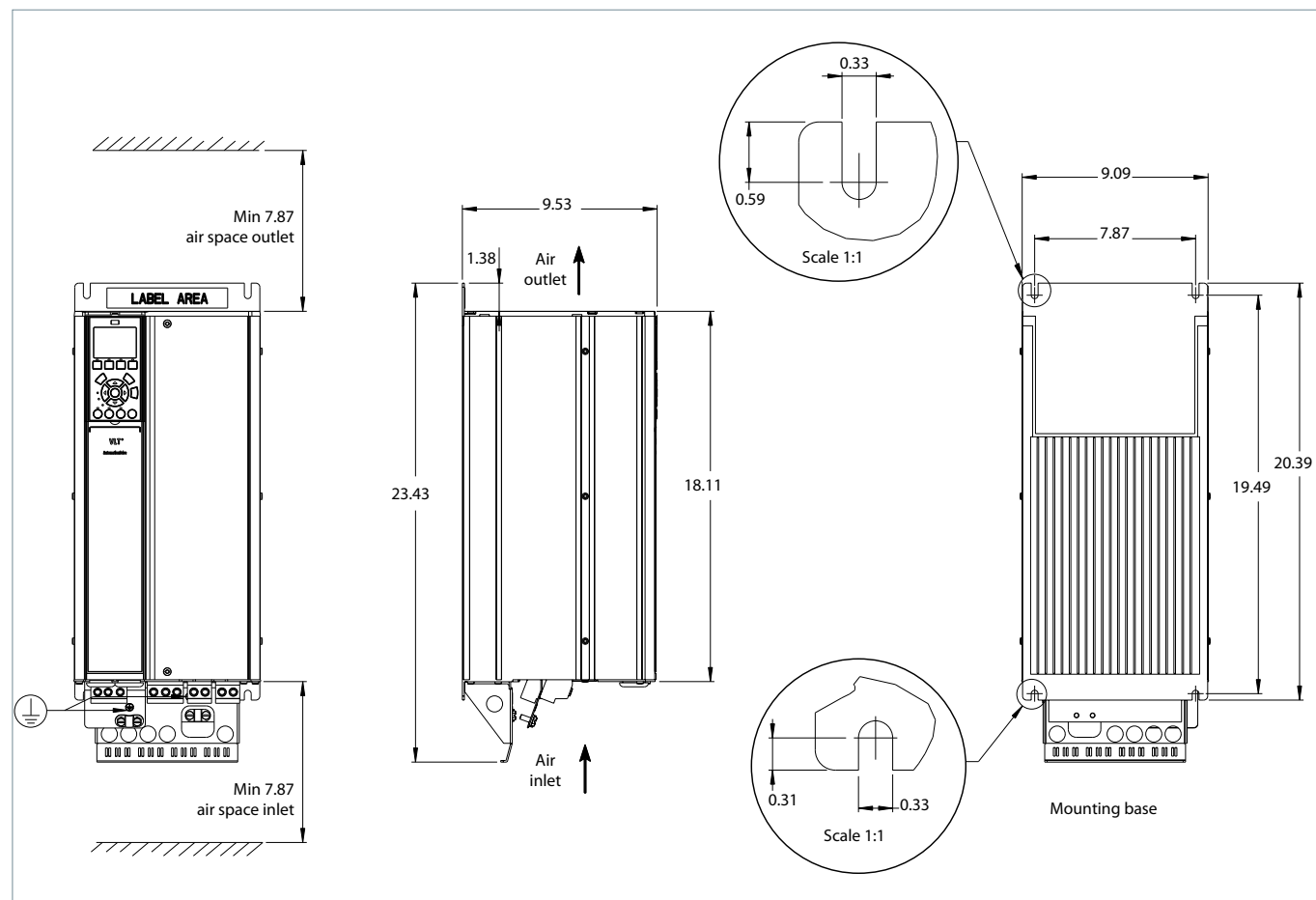


CDS302 frequency converter - enclosure B4

380-480 volts – 18-22 kW - IP20 housing

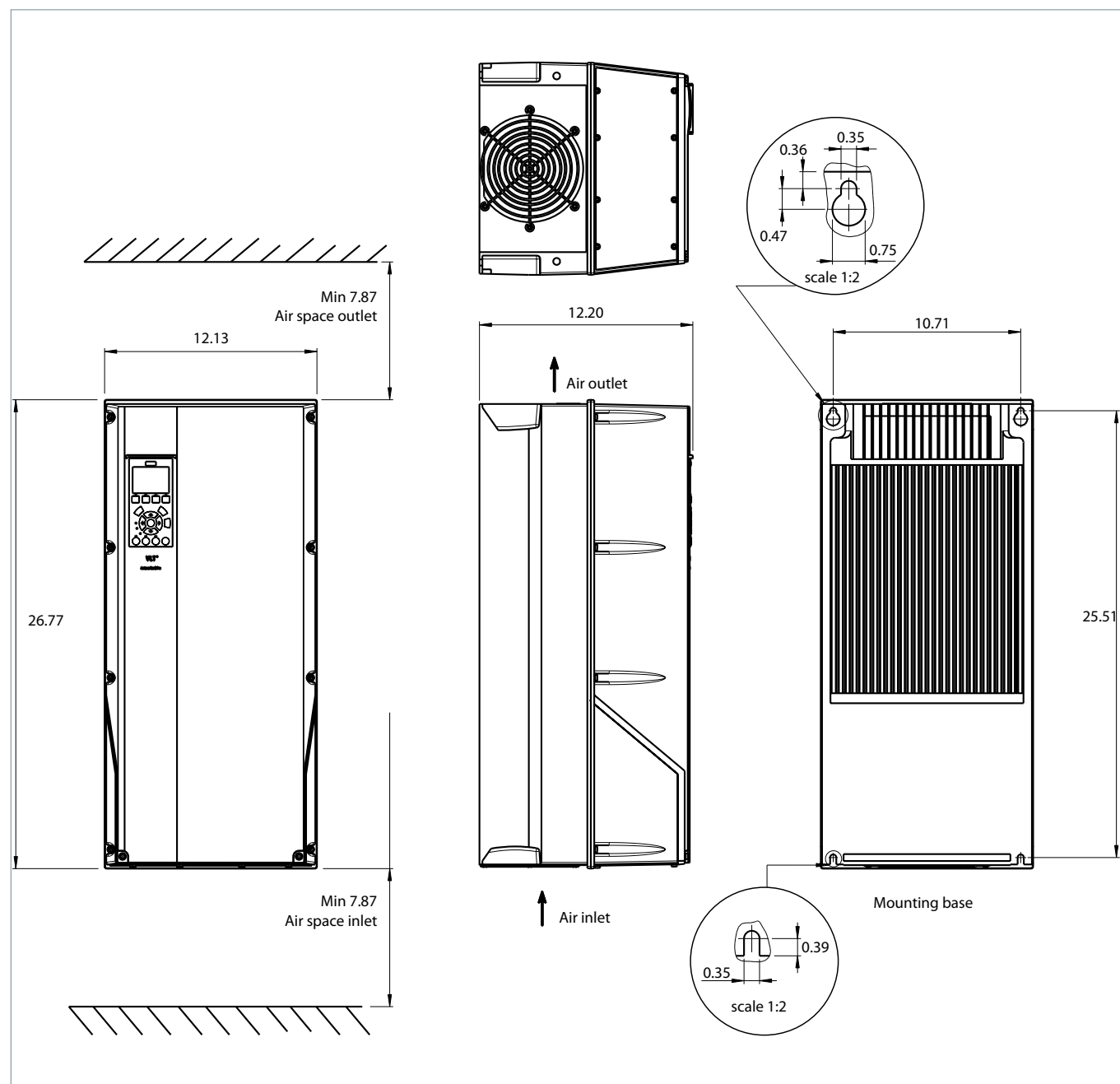
525-600 volts – 18-22 kW - IP20 housing

200-240 volts – 15 kW - IP20 housing



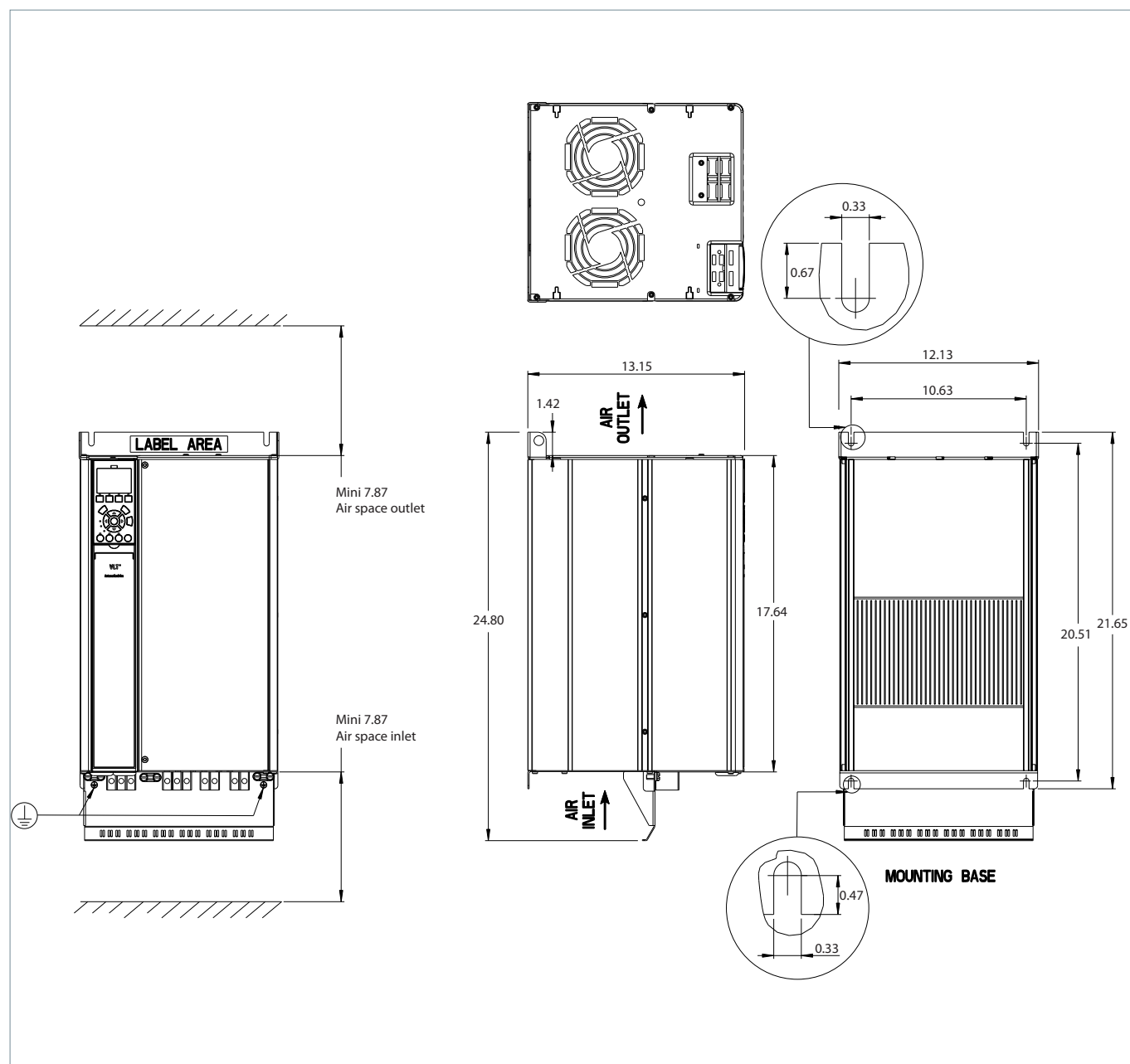
CDS302 frequency converter - enclosure C1

200-240 volts – 15-18-22 kW - IP55 housing



CDS302 frequency converter - enclosure C3

200-240 volts – 18-22 kW - IP20 housing



Application guidelines

Electrical data, connections and wiring

Supply voltage

Because VSH compressors are powered by a frequency converter, the mains frequency, 50 or 60 Hz, is no longer an issue. Only the mains voltage is to be taken into account. With 3 motor voltage codes, the most common mains voltages and frequencies are covered. Never connect the VSH compressor directly to the mains power supply.

| Voltage code | Mains voltage range of drive |
|--------------|--|
| J | 200-240 V / 3 ph / 50 Hz & 200-240 V / 3 ph / 60 Hz (±10%) |
| G | 380-480 V / 3 ph / 50 Hz & 380 - 480 V / 3 ph / 60 Hz (±10%) |
| H | 525-600 V / 3 ph / 50 Hz & 525-600 V / 3 ph / 60 Hz (±10%) |

Compressor electrical specifications

| | Compressor | RW (Ohm) | RLA (A) | MMT (A) | LRA (A) |
|----------------|------------|-------------|------------|------------|------------|
| 200 - 240 Volt | VSH088-J | 0.0191 | 61.5 | 76.9 | 346 |
| | VSH117-J | 0.0138 | 80 | 100 | 471 |
| | VSH170-J | 0.0280 | 120 | 150 | 699 |
| 380 - 480 Volt | VSH088-G | 0.26 | 29.9 | 37.4 | 159 |
| | VSH117-G | 0.185 | 37.7 | 47.1 | 225 |
| | VSH170-G | 0.127 | 57.3 | 71.6 | 346 |
| 525 - 600 Volt | VSH088-H | 0.518 | 21 | 26.3 | 115 |
| | VSH117-H | 0.366 | 30.8 | 38.5 | 157 |
| | VSH170-H | 0.238 | 44 | 55.0 | 246 |

RW: Winding resistance per winding (in CDS302 parameter list)

RLA: Rated load current

MMT: Maximum must trip current

LRA: Locked rotor current

Note that parameter 1-30 in the frequency converter settings reflects the winding resistance per winding. This is not the same value as measured at the motor terminals.

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the higher average current as measured on mechanically blocked compressor tested under nominal voltage. As required by UL regulation, this value is printed

on the nameplate. This current value can not be achieved in the case of VSH compressors, because the frequency converter will cut-out the mains before, according to MMT value.

RLA (Rated Load Amp)

Rated Load Amp value is the current value at maximum load, in the operating envelope, and at maximum speed.

MMT (Maximum Must Trip current)

The Maximum Must Trip current is defined for compressors not equipped with their own motor protection. This MMT value is the maximum at which the compressor can be operated in transient conditions and out of the operating envelope. The tripping current of external

over-current protection must never exceed the MMT value.

For VSH compressors, according to UL requirements, MMT value is 125% of RLA. This value is printed on the compressor nameplate.

Fuses

| Frequency converter | | EN50178 compliant fuses | | UL Compliant fuses | | | | | |
|---------------------|-------------|-------------------------|------|--------------------|---------|---------|-------------|-------------|----------|
| | | | | Bussmann | | | SIBA | Little fuse | |
| | | Size | Type | Type RK1 | Type J | Type T | Type RK1 | Type RK1 | Type RK1 |
| 200-240 V | CDS-15kW | 125 A | gG | KTN-R125 | JKS-150 | JJN-125 | 2028220-125 | KLN-R125 | A2K-125R |
| | CDS-18.5 kW | 125 A | gG | KTN-R125 | JKS-150 | JJN-125 | 2028220-125 | KLN-R125 | A2K-125R |
| | CDS-22 kW | 160 A | gG | FWX-150 | - | - | 2028220-150 | L25S-150 | A25X-150 |
| 380-480 V | CDS-15 kW | 63 A | gG | KTS-R50 | JKS-50 | JJS-50 | 5014006-050 | KLS-R50 | A6K-50R |
| | CDS-18.5 Kw | 63 A | gG | KTS-R60 | JKS-60 | JJS-60 | 5014006-063 | KLS-R60 | A6K-60R |
| | CDS-22 kW | 80 A | gG | KTS-R80 | JKS-80 | JJS-80 | 2028220-100 | KLS-R80 | A6K-80R |
| 525-600 V | CDS-15 kW | - | - | KTS-R50 | JKS-50 | JJS-50 | 5014006-050 | KLS-R50 | A6K-50R |
| | CDS-18.5 kW | - | - | KTS-R60 | JKS-60 | JJS-60 | 5014006-063 | KLS-R60 | A6K-60R |
| | CDS-22 kW | - | - | KTS-R80 | JKS-80 | JJS-80 | 2028220-100 | KLS-R80 | A6K-80R |

Application guidelines

Electrical data, connections and wiring

Wire sizes

Below table lists recommended wiring sizes for the motor compressor power supply cables. These wiring sizes are valid for a cable length up to 66 ft.

| | From network to frequency converter | | | From frequency converter to compressor | | |
|-------------|-------------------------------------|-------------------|-----|--|-------------------|-----|
| | Type | inch ² | AWG | Type | inch ² | AWG |
| 200 - 240 V | CDS-15kW | 0.039 | 4 | VSH088-J | 0.039 | 4 |
| | CDS-18.5 kW | 0.054 | 2 | VSH117-J | 0.054 | 2 |
| | CDS-22 kW | 0.077 | 1 | VSH170-J | 0.077 | 1 |
| 380 - 400 V | CDS-15 kW | 0.009 | 10 | VSH088-G | 0.009 | 10 |
| | CDS-18.5 Kw | 0.015 | 8 | VSH117-G | 0.015 | 8 |
| | CDS-22 kW | 0.025 | 6 | VSH170-G | 0.025 | 6 |
| 525 - 600 V | CDS-15 kW | 0.006 | 12 | VSH088-H | 0.006 | 12 |
| | CDS-18.5 kW | 0.009 | 10 | VSH117-H | 0.009 | 10 |
| | CDS-22 kW | 0.015 | 8 | VSH170-H | 0.015 | 8 |

Wiring & EMC protection

The motor compressor power supply from the CDS302 frequency converter to the VSH compressor must be done with a braided screened / armored cable. This cable needs to have its screen / armor conduit connected to earth on both ends. Avoid terminating this cable connection with twisting ends (pigtails) because that would result in an antenna phenomena and decreases the effectiveness of the cable.

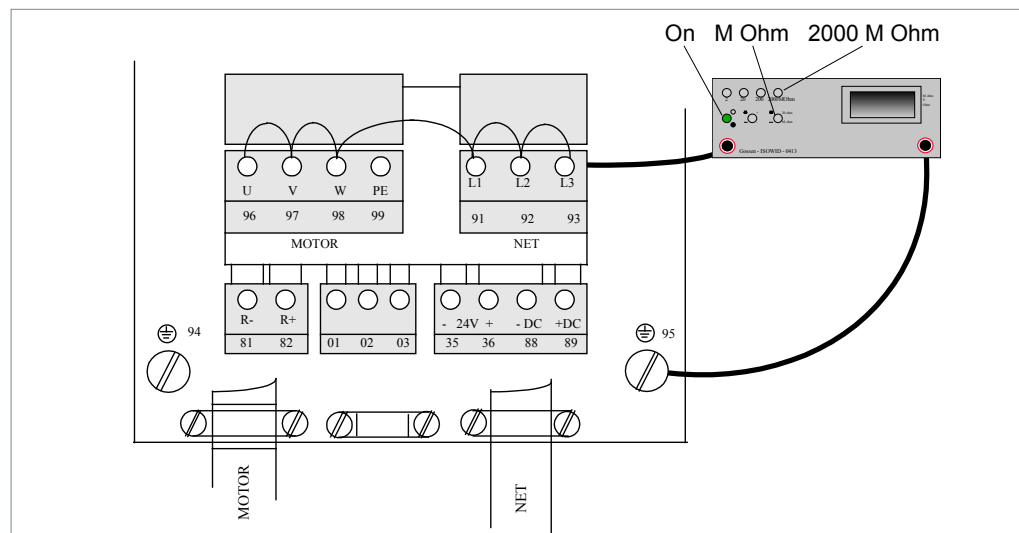
Control cables to the CDS302 frequency converter must use the same installation principles as the power supply cable.

The motor compressor cable must be installed in a conduit separate from the control and mains cables.

Physical installation of the frequency converter on the mounting plate must ensure good electrical contact between the mounting plate and the metal chassis of the converter. Use star-washers and galvanically conductive installation plates to secure good electrical connections. Refer to instructions MG.34.M1.02 for tightening torques and screw sizes.

Note that the CDS302 must be mounted on a plain wall to ensure a good air flow through its heat exchanger.

Hipot test procedure



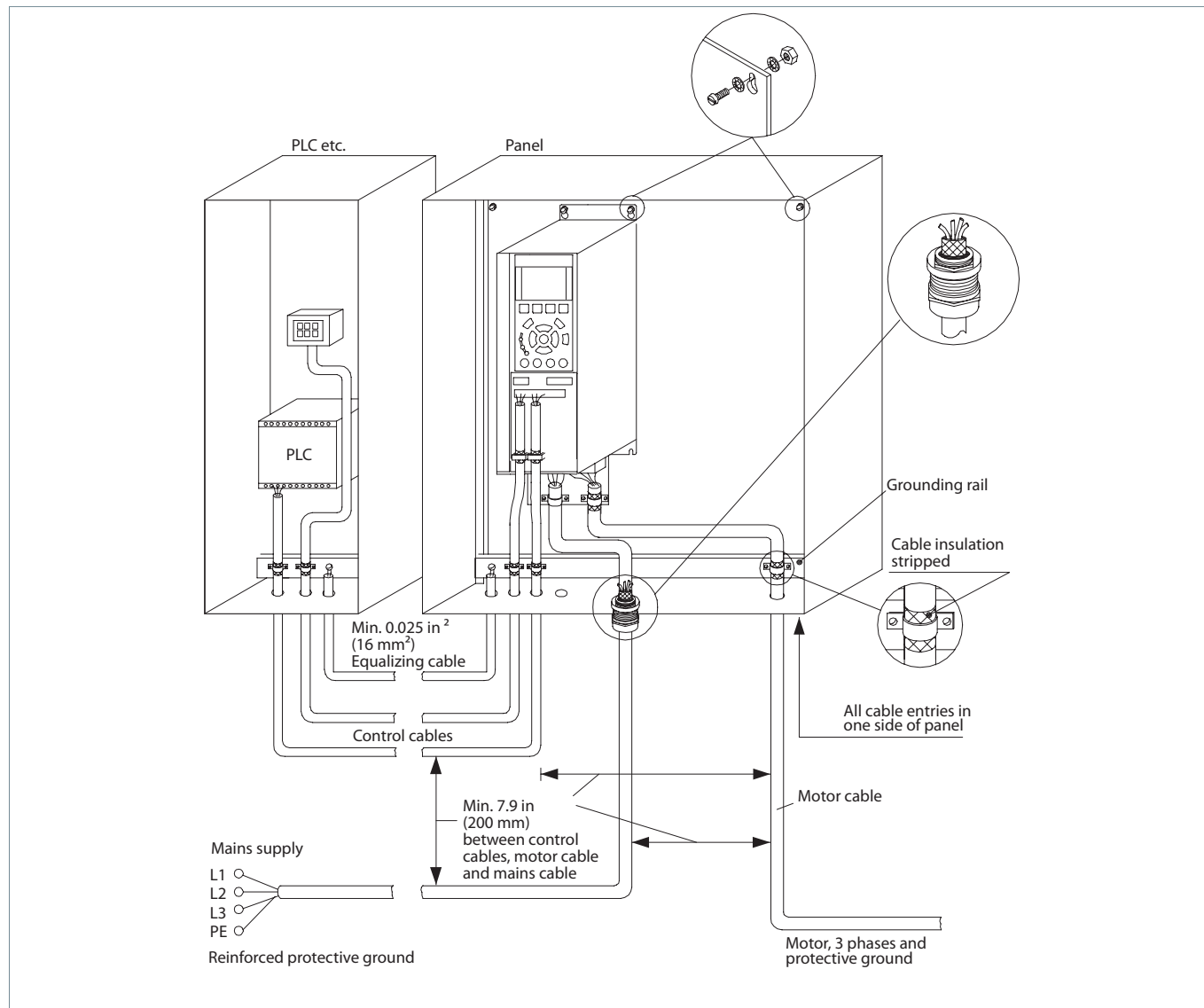
It is not necessary to perform a Hipot test (dielectric withstand test) on frequency converters. This has already been done during factory final test.

If a Hipot test has to be done anyway, following instructions must be followed in order to not damage the frequency converter:

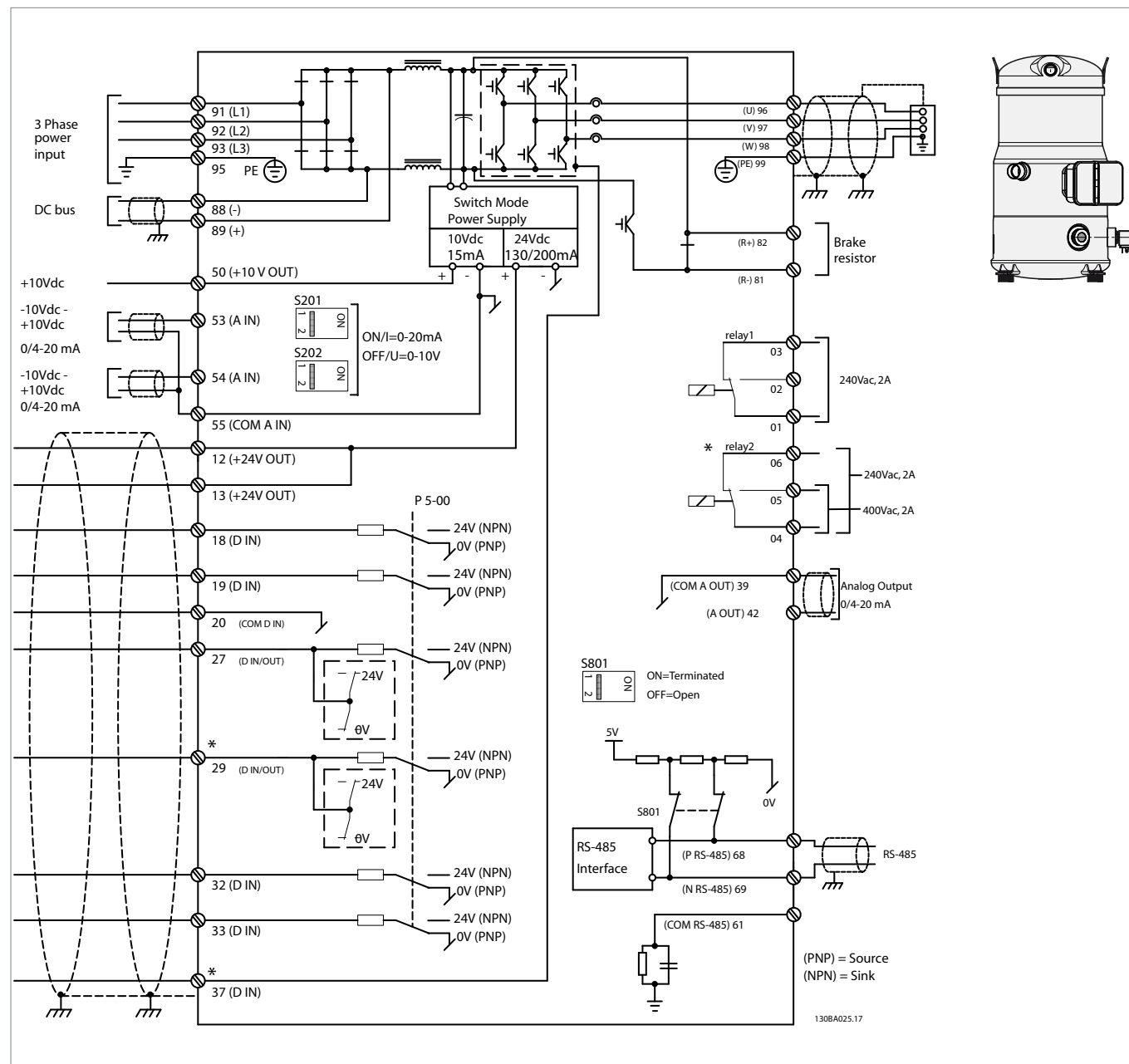
- Compressor not connected
- L1, L2, L3, U, V, W terminals must be shorted and connected to high voltage terminal of the testing device.
- Ground terminal (chassis) must be connected to low voltage terminal of the testing device.
- 2150VDC must be applied
- Ramp up time 3 seconds
- Full DC voltage must be established during 2 seconds
- The current leakage during the test must be below 1mA
- Ramp down time to 0V in 25 seconds.

EMC correct installation of an IP20 frequency drive CDS302

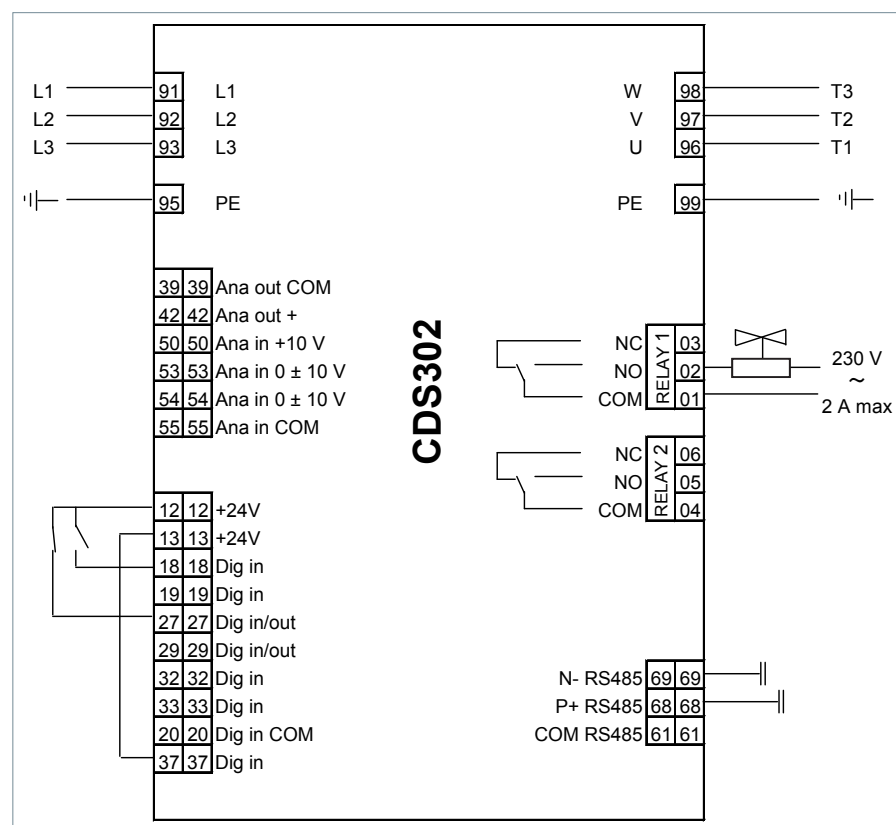
EMC qualification reports are available upon request to Danfoss technical support.



Wiring diagram



Wiring connections



| | | Open loop | Process loop |
|------------|------------------------------------|-----------|--------------|
| 91, 92, 93 | 3 Phase mains input | X | X |
| 95 | Earth | X | X |
| 39, 42 | Analogue output | - | - |
| 50 | Analogue input | - | - |
| 53 | PLC+ (0 to 10 V) | X | - |
| 54 | Sensor - | - | X |
| 55 | PLC- | X | - |
| 12 | HP/LP switch | X | X |
| 12 | External On/Off (NO) | X | X |
| 13 | Factory bridged to 37 | X | X |
| 13 | Sensor + | - | X |
| 18 | External On/Off (NO) | X | X |
| 19 | Digital input | - | - |
| 27 | HP/LP switch (NC) / safety devices | X | X |
| 29 | Digital input/output | - | - |
| 32, 33 | Digital input | - | - |
| 20 | Digital input Common | - | - |
| 37 | Factory bridged to 13 | X | X |
| 98 | To compressor terminal T3 | X | X |
| 97 | To compressor terminal T2 | X | X |
| 96 | To compressor terminal T1 | X | X |
| 99 | To compressor earth connection | X | X |
| 02, 01 | Relay 1 to oil solenoid valve | X | X |
| 06, 05, 04 | Relay 2 | - | - |
| 69, 68 | RS485 Bus | - | - |
| 61 | RS485 Bus Common | - | - |

- : Optional connection
X : Mandatory connection

The CDS302 frequency converter is factory pre-set with parameters for the open loop control principle. The process loop control principle can be selected by changing parameters in the «Quick menu».

Open loop: preset on input 53

0 - 10 V control

Frequency converter in slave mode

Process loop: preset on input 54

4 - 20 mA control

Frequency converter under own PID controller

| Application guidelines | Electrical data, connections and wiring | |
|---|--|--|
| Electrical connections | <p>Electrical power is connected to the compressor terminals by Ø 3/16" screws. The maximum tightening torque is 2ft.lbs. Use a 1/4" ring terminal on the power leads.</p> | <p>The cable gland has to be of EMC design to guaranty a good grounding of the armored cable.</p> <p>Paint free areas on electrical box allow correct ground continuity.</p> |
| Soft-start control | <p>The CDS302 frequency converter generates by design a compressor soft start with an initial ramp up of 0.9 sec.</p> <p>Current inrush is at highest the frequency con-</p> | <p>verter maximum current.</p> <p>Basically seen from the mains the inrush peak reach a level which is only a few percent more than the rated nominal current.</p> |
| Phase sequency and reverse rotation protection | <p>The CDS302 frequency converter is preset to run the VSH compressors clockwise so the only care is to well connect the CDS302 output to the compressor connectors:</p> <ul style="list-style-type: none"> • CDS302 terminal U (96) to VSH terminal T1/U • CDS302 terminal V (97) to VSH terminal T2/V • CDS302 terminal W (98) to VSH terminal T3/W | <p>Mains connection to the CDS302 frequency converter order has no influence on the output phase sequence which is managed by the frequency converter.</p> |

Application guidelines

Electrical data, connections and wiring

IP rating

The compressor terminal box IP rating according to CEI529 is IP54 when correctly sized IP54 rated cable glands are used.

Motor protection

Motor protection is provided by the frequency converter. All parameters are factory preset in order to guaranty locked rotor or overload current protection.

When a warning situation is reached in the current control, the CDS302 frequency converter will automatically reduce the compressor speed in order to keep the motor current of the compressor below the maximum allowed.

Voltage imbalance

The maximum allowable voltage imbalance between each phases is 3%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible drive damage.

Mains imbalance function in CDS302 frequency converter can be set to "[0] Trip" or "[1] Warning" in 14.12 parameter. It is, by default, factory preset to "[1] Warning".

Frequency converter efficiency

| Drive supply voltage | Drive power kW | Compressor voltage code | Compressor model | IP20 / IP55 | | |
|----------------------|----------------|-------------------------|------------------|-----------------|--------------------------------------|------------|
| | | | | Drive enclosure | Estimated power loss at max load (W) | Efficiency |
| T2: 200-240/3/50-60 | 15 | J | VSH088 | B4 / C1 | 624 | 0.96 |
| | 18.5 | | VSH117 | C3 / C1 | 740 | 0.97 |
| | 22 | | VSH170 | C3 / C1 | 874 | 0.97 |
| T4: 380-480/3/50-60 | 15 | G | VSH088 | B3 / B1 | 379 | 0.98 |
| | 18.5 | | VSH117 | B4 / B2 | 444 | 0.98 |
| | 22 | | VSH170 | B4 / B2 | 547 | 0.98 |
| T6: 525-600/3/50-60 | 15 | H | VSH088 | B3 / B1 | 285 | 0.98 |
| | 18.5 | | VSH117 | B4 / B2 | 329 | 0.98 |
| | 22 | | VSH170 | B4 / B2 | 700 | 0.98 |

Ambient temperature and altitude

The normal ambient temperature supported by the frequency converter covers a range from -10°C to +50°C without any issue or derating. Anyhow, the frequency converter will operate normally down to -20°C where only the screen of the LCP (if installed) will show display issues without being damaged.

For ambient temperatures above +50°C, it is mandatory to integrate a derating output factor for the maximum compressor electrical motor power/current. The derating values are shown in the drive application manual and are linked to the drive frame and IP protection level.

For altitudes below 1000 m, the frequency converter will be able to deliver 100% output power under full load for above ambient temperature. However, for altitudes above 1000 m derating must be applied with following values.

| Altitude | Derating factor |
|----------|-----------------|
| 1000 m | 1 |
| 1500 m | 0.95 |
| 2000 m | 0.90 |
| 2500 m | 0.86 |
| 3000 m | 0.82 |
| 3500 m | 0.78 |

For more details about these specific running conditions, please contact Danfoss technical support.

Application guidelines

Approvals and certificates

Approvals and certificates

VSH compressors comply with the following approvals and certificates.

| | | |
|---|---|------------------------------|
| CE 0062 or CE 0038 (European Directive) |  | All VSH models except code H |
| UL (Underwriters Laboratories) |  | All VSH models |
| EMC 2004 / 108 / EC | | All VSH models |

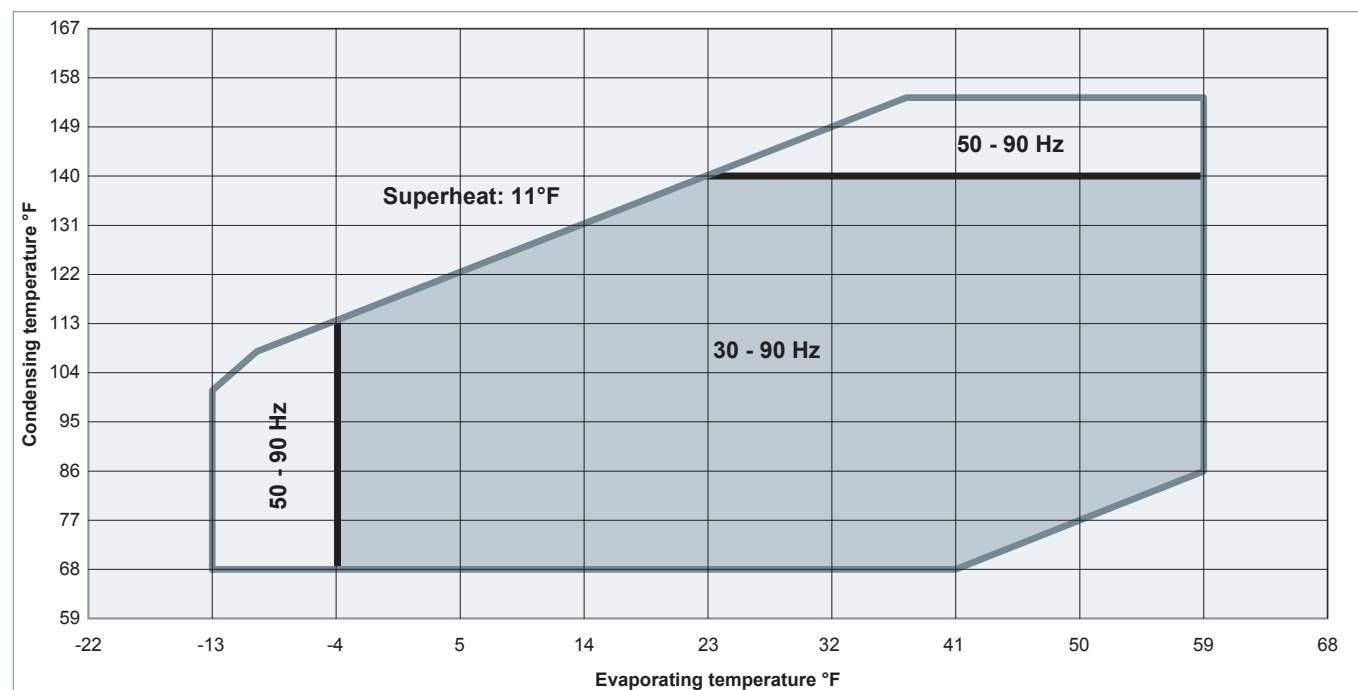
Pressure equipment directive 97/23/EC

| Products | VSH088 | VSH117 | VSH170 |
|-----------------------------|---------------------|----------|---------------------|
| Fluids | Group 2 | | |
| Category PED | II | | |
| Evaluation module | D1 | | |
| TS - service temperature LP | -31°F < TS < +131°F | | -31°F < TS < +124°F |
| PS - service pressure LP | 483 psig | 483 psig | 438 psig |

Internal free volume

| Products | Internal free volume at LP side without oil (inch ³) |
|----------|--|
| VSH088 | 671 |
| VSH117 | 781 |
| VSH170 | 1751 |

Application envelope



Short cycle timer function

Short cycle control is directly provided by the CDS302 frequency converter, when parameter 28.0* is enabled.

The function is factory set to enabled, with minimum running time 12 seconds and interval between starts 300 seconds.

Short cycle settings are accessible in parameter 28.0* list, in the "compressor functions" menu.

Discharge gas temperature protection function

A discharge temperature monitor function can be enabled in the frequency converter. All settings are available in parameter list 28.2*, they are factory preset as follow:

- 28.20: [0] none - temperature source (sensor input)
- 28.21: [60] °C - temperature unit
- 28.24: 130 - warning level
- 28.25: [1] decrease cooling - warning action
- 28.26: 145 - emergency level
- 28.27: is the actual discharge temperature measured by the sensor.

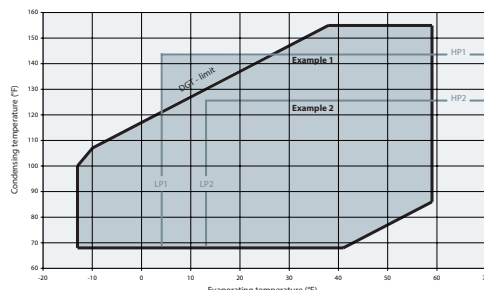
To activate the discharge temperature monitor function, with the factory setting, the only modification required is to connect the sensor to Analog Input 54 (4.20 mA) between 13 and 54, and set the parameter 28.20 to "[2] Analog input 54". When the warning level is reached "decrease cooling" action starts by decreasing the compressor speed by steps of 600 rpm (10 Hz) every 3 minutes until the temperature, either drops below the level, programmed in parameter 28.24 (warning level) or exceed the level programmed in parameter 28.26 (emergency level). When the emergency level is reached, the compressor is stopped and the frequency converter shows an "alarm".

Application guidelines

Operating conditions

Discharge gas thermostat

Discharge gas temperature (DGT) protection is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope.



Example 1 (R410A, SH = 20°F)

LP switch setting:

LP1 = 48 psig (4.1°F)

HP switch setting:

HP1 = 551 psig (143.6°F)

Risk of operation beyond the application envelope.

DGT protection required.

Example 2 (R410A, SH = 20°F)

LP switch setting:

LP2 = 67 psig (13.1°F)

HP switch setting:

HP2 = 450 psig (125.6°F)

No risk of operation beyond the application envelope.

No DGT protection required.

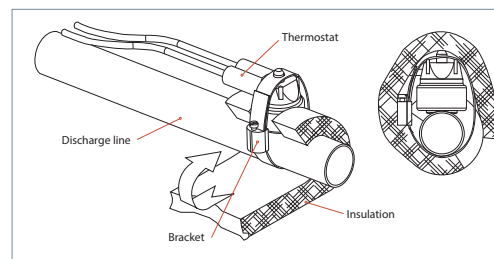
The discharge gas temperature must not exceed 275°F.

A discharge gas temperature protection device must be installed on all heat pumps. In reversible air-to-air and air-to-water heat pumps the discharge temperature must be monitored during development test by the equipment manufacturer.

The compressor must not be allowed to cycle on the discharge gas thermostat. Continuous operations beyond the compressor's operating range will cause serious damage to the compressor!

A DGT accessory is available from Danfoss: refer to accessories pages at the end of this document.

The discharge gas thermostat accessory kit (code no.7750009) includes all components required for installation, as shown below. The thermostat must be attached to the discharge line within 5.91 inch from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.



Oil return management function

Insufficient oil level can be the result of oil depositing itself in pipes and heat exchangers. The oil deposit can be returned to the crankcase, by increasing velocity for short period, at regular time intervals or when velocity is too low to ensure adequate oil returns.

With oil return management these two oil return mechanisms can be programmed in the CDS302.

Refer to section "Oil level checking and top-up" at the end of this document for details.

Application guidelines

System design recommendations

High and low pressure protection

High pressure

According to EN378-2, a high-pressure (HP) safety switch is required to shut down the compressor. The high-pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be placed in a lockout circuit or consist of a manual reset

device to prevent cycling around the high-pressure limit. If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which must not be isolated. The lock-out circuit or HP switch must be connected to the CDS302 input 27.

Low pressure

A low-pressure (LP) safety switch must be used. Deep vacuum operations of a scroll compressor can cause internal electrical arcing and scroll instability. VSH compressors exhibit high volumetric efficiency and may draw very low vacuum levels, which could induce such a problem. The minimum low-pressure safety switch (loss-of-charge safety switch) setting is given in the following table. For systems without

pump-down, the LP safety switch must either be a manual lockout device or an automatic switch wired into an electrical lockout circuit. The LP switch tolerance must not allow for vacuum operations of the compressor. LP switch settings for pump-down cycles with automatic reset are also listed in the table below. Lock-out circuit or LP switch or series with other safety devices (HP, ...) must be connected to CDS302 input 27.

Pressure settings

| Pressure settings | | R410A |
|--|------|-----------|
| Working pressure range high side | psig | 195 - 645 |
| Working pressure range low side | psig | 33 - 168 |
| Maximum high pressure safety switch setting | psig | 652 |
| Minimum low pressure safety switch setting * | psig | 21 |
| Minimum low pressure pump-down switch setting ** | psig | 33 |

*LP safety switch shall never be bypassed.

** Recommended pump-down switch settings: 21 psig below nominal evaporating temperature with minimum of 33 psig

Electronic expansion valve

With variable capacity systems, an electronic expansion valve (EXV) is one of the better solutions to handle refrigerant mass flow variations. Ramp-up and ramp-down settings, of both EXV and compressor, must be done with great care.

Ramp-up of the EXV must be shorter than the ramp-up of the compressor, to avoid any low pressure operation on suction side of the compressor. The EXV can also be opened, up

to a certain degree, before the start up of the compressor.

Ramp-down of the EXV must be longer than the ramp-down of the compressor, also to avoid low pressure operation (except with pump-down).

EXV should be closed, and remained closed, when the compressor is off, to avoid any liquid refrigerant entering the compressor.

Crankcase heating function

A DC-hold current through the motor windings can be used as an alternative to an external crankcase heater to keep the compressor warm when stopped.

For VSH088 and VSH117 this function is factory preset to "enabled". Go to parameter 28.3* in the frequency converter for settings (factory presets are done).

For VSH170, this function must not be used and is factory preset to "disabled". An external crankcase heater is required, and surface sump heater type should be preferred. Refer to accessory list for code numbers.

Application guidelines

System design recommendations

Essential piping design considerations

The working pressure in systems with R410A is about 60% higher than in systems with R22 or R407C. Consequently, all system components and piping must be designed for this higher pressure level.

Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil and refrigerant migration back to the compressor during off-cycles.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to

In systems with R410A, the refrigerant mass flow will be lower compared to R22/R407C systems. To maintain acceptable pressure drops and acceptable minimum gas velocities, the refrigerant piping must be reduced in size compared to R22 / R407C systems. Take care not to create too high pressure drops neither since in R410A systems the negative impact of high pressure drops on the system efficiency is stronger than in R22/ R407C systems.

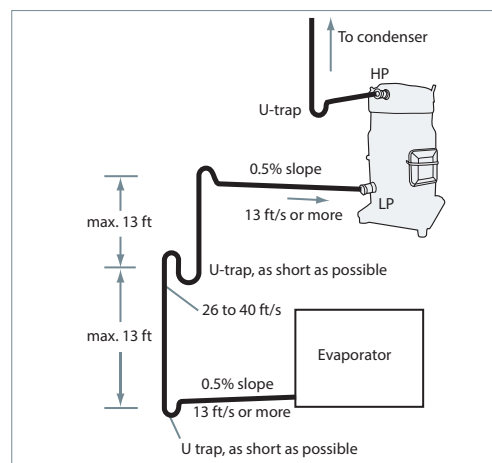
the surrounding structure and generate an unacceptable noise level within that structure as well. For more information on noise and vibration, see «Sound and Vibration Management» section.

CDS302 frequency converter integrates a special feature in the compressor functions in order to improve and secure the oil recovery from the system. Refer to “Oil Return Management” section.

Suction lines

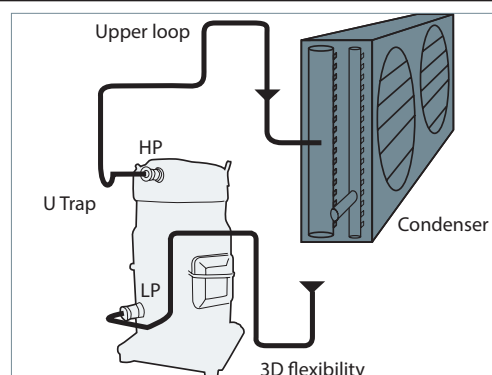
If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.

If the evaporator were situated below the compressor, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the outlet of the evaporator while the system is idle, which would mislead the expansion valve's sensor (thermal bulb) at start-up.



Discharge lines

When the condenser is mounted at a higher position than the compressor, a suitably sized «U»-shaped trap close to the compressor is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressor during off cycle. The upper loop also helps avoid condensed liquid refrigerant from draining back to the compressor when stopped.



Application guidelines

System design recommendations

Heat exchangers

To obtain optimum efficiency of the complete refrigerant system, optimized R410A heat exchangers must be used. R410A refrigerant has good heat transfer properties: it is worthwhile designing specific heat exchangers to gain in size and efficiency.

An evaporator with optimized R410A distributor and circuit will give correct superheat at outlet and optimal use of the exchange surface. This is critical for plate evaporators that have generally a shorter circuit and a lower volume than shell & tubes and air cooled coils.

For all evaporator types a special care is required for superheat control leaving the evaporator and oil return.

A sub-cooler circuit in the condenser that creates high sub-cooling will increase efficiency at high condensing pressure. In R410A systems the positive effect of sub-cooling on system efficiency will be significantly larger than in R22/R407C systems.

Furthermore, for good operation of the expansion device and to maintain good efficiency in the evaporator it is important to have a high degree of liquid sub-cooling. Without adequate sub-cooling, flash gas will be formed at the expansion device resulting in a high degree of vapour at the evaporator inlet leading to low efficiency.

Refrigerant charge limits

VSH compressors can tolerate liquid refrigerant up to a certain extend without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited. In this respect, follow the guidelines given in the section: "Essential piping design recommendations" in priority.

If the refrigerant charge exceeds the values in below table, a suction line accumulator is strongly recommended.

| Model | Refrigerant charge limit (lb) |
|--------|-------------------------------|
| VSH088 | 13 |
| VSH117 | 17 |
| VSH170 | 30 |

More detailed information can be found in the paragraphs hereafter. Please contact Danfoss technical support for any deviation from these guidelines.

Liquid refrigerant can find its way into the compressor by means of off-cycle migration or liquid flood-back during operation.

Off-cycle migration

Off-cycle refrigerant migration is likely to occur when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid is allowed to migrate from the evaporator into the compressor sump by gravity. If too much liquid refrigerant accumulates in the sump it will saturate the oil and lead to a flooded start: when the compressor starts running again, the refrigerant evaporates abruptly under the sudden decrease of the bottom shell pressure, causing the oil to foam. In extreme situations, this might result in liquid slugging (liquid entering the scroll elements), which must be avoided as it causes irreversible damage to the compressor.

The presence of liquid in the crankcase can be easily detected by checking the sump level through the oil sight glass. Foam in the oil sump indicates a flooded start.

VSH scroll compressors can tolerate occasional flooded starts as long as the total system charge does not exceed the maximum compressor refrigerant charge.

Off-cycle migration can be prevented by implementing a crankcase heating or adding a pump-down cycle to the operation cycle and a liquid line solenoid valve.

Crankcase heater / sump heater: When the compressor is idle, the oil temperature in the sump of the compressor must be maintained at no lower than 18°F above the saturation temperature of the refrigerant on the low-pressure side. This requirement ensures that the liquid refrigerant is not accumulating in the sump.

A crankcase heater is only effective if capable of sustaining this level of temperature difference. Tests must be conducted to ensure that the ap-

propriate oil temperature is maintained under all ambient conditions (temperature and wind).

Provide separate electrical supply for the heaters so that they remain energized even when the machine is out of service (eg. seasonal shut-down).

Refer to section “Crankcase heating function” for details and settings of crankcase heating function integrated in the drive.

Liquid line solenoid valve (LLSV): An LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer or excessive migration to the compressor during off-cycles. When installed,

EXV ensures also this function. The quantity of refrigerant on the low-pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.

Pump-down cycle: A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of liquid refrigerant. Once the system has reached its set point and is about to shut off, the LLSV on the condenser outlet closes. The compressor then pumps the majority of the refrigerant charge into the condenser and receiver before the

system stops on the low pressure pump-down switch. This step reduces the amount of charge on the low side in order to prevent off-cycle migration. The recommended low-pressure pump-down switch setting is 21 psig below the nominal evaporating pressure. It shall not be set lower than 33 psig.

Liquid receiver: Refrigerant charge optimisation varies with compressor speed. To avoid flash gas at low speed, a receiver may be necessary.

Receiver dimensioning requires special attention. The receiver shall be large enough to contain part of the system refrigerant charge, but shall not be too large, to avoid refrigerant overcharging during maintenance operations.

Liquid floodback during operation

Liquid floodback occurs when liquid refrigerant returns to the compressor when it is running. During normal operation, refrigerant leaves the evaporator and enters the compressor as a superheated vapour. The suction gas can still contain liquid refrigerant for example with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters. A continuous liquid floodback will cause oil dilution and, in extreme situations, lead to liquid slugging.

VSH scroll compressors can tolerate occasional liquid floodback. However system design must be such that repeated and excessive floodback is not possible.

During operations, liquid floodback may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 18°F or less above the saturated suction temperature, or should the discharge gas temperature be less than 63°F above the saturated discharge temperature, this indicates liquid floodback. Repetitive liquid floodback testing must be carried out under TXV threshold operating conditions: a high pressure ratio and minimum evaporator load, along with the measurement of suction superheat, oil sump temperature and discharge gas temperature.

| Application guidelines | Specific application recommendations | |
|--|---|---|
| Low ambient compressor operations | | |
| Low ambient operations and minimum pressure differential at steady running conditions | <p>The VSH compressor requires a minimum pressure differential of 87 to 102 psig between the suction and discharge pressures to force the orbiting scroll-down against the oil film on the thrust bearing. Anything less than this differential and the orbiting scroll can lift up, causing a metal-to-metal contact. It is therefore necessary to maintain sufficient discharge pressure in order to</p> | <p>ensure this pressure differential. Care should be taken during low ambient operations when heat removal from air-cooled condensers is greatest and head pressure control may be required for low ambient temperature applications. Operation under low pressure differential may be observed by a significant increase in the sound power level generated by the compressor.</p> |
| Low ambient start-up | <p>Under cold ambient conditions, upon start-up the pressure in the condenser may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator. As a result, the compressor may go into abnormal low suction pressure, which can lead to compressor failure. Under no circumstances should the compressor be allowed to operate under vacuum. The low-pressure control must be set in accordance with the table</p> | <p>section "Pressure settings" in order to prevent this from happening.</p> <p>Low pressure differentials can also cause the expansion device to «hunt» erratically, which might cause surging conditions within the evaporator, with liquid spillover into the compressor. This effect is most pronounced during low load conditions, which frequently occur during low ambient conditions.</p> |
| Head pressure control under low ambient conditions | <p>Several possible solutions are available to prevent the compressor from drawing down to a vacuum upon start-up under low ambient conditions. In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level.</p> <p>Note: The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes.</p> | <p>Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a liquid receiver with condenser and receiver pressure regulators would be possible.</p> <p>Condensing pressure control is also strongly recommended to improve any system efficiency. The most accurate value is to control the condensing temperature at 22°F above the ambient temperature for air cooled condensers.</p> <p>For further information, please contact Danfoss Technical support.</p> |
| Crankcase heaters | <p>A crankcase heating will minimize refrigerant migration caused by the large temperature gradient between the compressor and the remainder of the system.</p> | <p>Refer to crankcase heating section "Crankcase heating function" for details and settings.</p> |
| Low load operations | <p>It is recommended that the unit be tested and monitored at minimum load and, if possible, during low ambient conditions as well. During conditions of low load on the system, the following considerations should be taken into</p> | <p>account to ensure proper system operating characteristics.</p> <ul style="list-style-type: none"> • The superheat setting of the expansion device should be sufficient to ensure proper superheat |

Application guidelines

Specific application recommendations

levels during low loading periods. 9 to 10.8°F stable superheat is required. In addition, the refrigerant charge should be sufficient to ensure proper sub-cooling within the condenser so as to avoid the risk of flashing in the liquid line before the expansion device. The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator.

An oversized valve may result in erratic control. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant super-heat control under varying loads.

- Condenser fans should be cycled in such a

way that the minimum pressure differential is maintained between the suction and discharge pressures. Variable speed fans can also be used to control the amount of heat to be removed from the condenser.

- The compressors should be run for a minimum period in order to ensure that the oil has sufficient time to properly return to the compressor sump and that the motor has sufficient time to cool under conditions of lowest refrigerant mass flows.

Refer to section "Oil return management function".

Brazed plate heat exchangers

A brazed plate heat exchanger needs very little internal volume to satisfy the set of heat transfer requirements. Consequently, the heat exchanger offers very little internal volume for the compressor to draw vapour from on the suction side. The compressor can then quickly enter into a vacuum condition. It is therefore important that the expansion device be sized correctly and that a sufficient pressure differential across the expansion device be available to ensure adequate refrigerant feed into the evaporator. This aspect is of special concern when operating the unit under low ambient and load conditions. For further information on these conditions, please refer to the previous sections.

Due to the small volume of the brazed plate heat exchanger, no pump-down cycle is normally required. The suction line running from the heat

exchanger to the compressor must be trapped to avoid refrigerant migration to the compressor.

When using a brazed plate condenser heat exchanger, a sufficient free volume for the discharge gas to accumulate is required in order to avoid excess pressure build-up. At least 1 meter of discharge line is necessary to generate this volume. To help reduce the gas volume immediately after start-up even further, the supply of cooling water to the heat exchanger may be opened before the compressor starts up so as to remove superheat and condense the incoming discharge gas more quickly.

Because of the large compressor capacity variation and VSH capability to run at low condensing temperature an EXV (electronic expansion valve) is mandatory.

Reversible heat pump systems

Transients are likely to occur in reversible heat pump systems, i.e. a changeover cycle from cooling to heating, defrost or low-load short cycles. These transient modes of operation may lead to liquid refrigerant carry-over (or flood-back) or excessively wet refrigerant return conditions. As such, reversible cycle applications require specific precautions for ensuring a long compressor life and satisfactory operating character-

istics. Regardless of the refrigerant charge in the system, specific tests for repetitive flood-back are required to confirm whether or not a suction accumulator needs to be installed. The following considerations cover the most important issues when dealing with common applications. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.

Discharge temperature monitoring

Heat pumps frequently utilize high condensing temperatures in order to achieve a sufficient temperature rise in the medium being heated. At the same time, they often require low evaporating pressures to obtain sufficient temperature differ-

entials between the evaporator and the outside temperature. This situation may result in high discharge temperature; as such, it is mandatory that a discharge gas safety control is carried to protect the compressor from exces

| Application guidelines | Specific application recommendations | |
|---|--|--|
| | <p>sive temperatures. Operating the compressor at too high discharge temperatures can result in mechanical damage to the compressor as well as thermal degradation of the compressor lubricating oil and a lack of sufficient lubrication.</p> | <p>Refer to section "Discharge gas temperature protection" function for frequency converter settings and accessories availability.</p> |
| Discharge line and reversing valve | <p>The VSH scroll compressor is a high volumetric machine and, as such, can rapidly build up pressure in the discharge line if gas in the line becomes obstructed even for a very short period of time which situation may occur with slow-acting, reversing valves in heat pumps. Discharge pressures exceeding the operating envelope may result in nuisance high-pressure switch cutouts and can generate excessive load on bearings and motor.</p> <p>To prevent such occurrences, it is important that a 39.4 ft minimum discharge line length be allowed between the compressor discharge port and the reversing valve or any other restriction. This gives sufficient free volume for the discharge</p> | <p>gas to collect and to reduce the pressure peak during the time it takes for the valve to change position. At the same time, it is important that the selection and sizing of the reversing or 4-way valve ensure that the valve switches quickly enough to prevent against too high discharge pressure and nuisance high-pressure cutouts.</p> <p>Check with the valve manufacturer for optimal sizing and recommended mounting positions.</p> <p>It is strongly recommended to reduce the compressor speed to 30Hz before the 4-way valve is moved from a position to another. Refer also to high and low pressure protection.</p> |
| Defrost and reverse cycle | <p>After the 4-way valve is moved to defrost position, and in order to shorten the defrost period, the compressor speed can be maintained at 70Hz during the defrost period.</p> | <p>When the compressor is started again, after defrost, it will run at 30Hz for a 10 seconds period. After this period it is recommended to maintain the speed at 50Hz for 10 to 15 seconds. Thus to avoid excessive liquid refrigerant to come back to the compressor sump.</p> |
| Suction line accumulator | <p>The use of a suction line accumulator is strongly recommended in reversible-cycle applications. This because of the possibility of a substantial quantity of liquid refrigerant remaining in the evaporator, which acts as a condenser during the heating cycle.</p> <p>This liquid refrigerant can then return to the compressor, either flooding the sump with refrigerant or as a dynamic liquid slug when the cycle</p> | <p>switches back to a defrost cycle or to normal cooling operations.</p> <p>Sustained and repeated liquid slugging and floodback can seriously impair the oil's ability to lubricate the compressor bearings. This situation can be observed in wet climates where it is necessary to frequently defrost the outdoor coil in an air source heat pump. In such cases a suction accumulator becomes mandatory.</p> |
| Water utilizing systems | <p>Apart from residual moisture in the system after commissioning, water could also enter the refrigeration circuit during operation. Water in the system shall always be avoided. Not only because it can shortly lead to electrical failure, sludge in sump and corrosion but in particular because it can cause serious safety risks. Common causes for water leaks are corrosion and freezing.</p> <p>Corrosion: Materials in the system shall be compliant with water and protected against corrosion.</p> | <p>Freezing: When water freezes into ice its volume expands which can damage heat exchanger walls and cause leaks. During off periods water inside heat exchangers could start freezing when ambient temperature is lower than 32°F. During on periods ice banking could occur when the circuit is running continuously at too low load. Both situations should be avoided by connecting a pressure and thermostat switch in the safety line.</p> |

Application guidelines

Sound and vibration management

Running sound level

For VSH170, an inferior hood is delivered with the SSH (Surface Sump Heater) to improve its heating efficiency. Noise level for VSH170 given below includes this inferior hood attenuation. For VSH088 and VSH117, inferior hood are not available.

| Model | Frequency (Hz) | Noise Level (dBA) |
|--------|----------------|-------------------|
| VSH088 | 30 | 67 |
| | 60 | 74 |
| | 90 | 84 |
| VSH117 | 30 | 68 |
| | 60 | 77 |
| | 90 | 85 |
| VSH170 | 30 | 68 (*) |
| | 60 | 79 (*) |
| | 90 | 88 (*) |

Sound power at ARI A/C conditions measured in free space.
(*) Level given with Surface Sump Heater and inferior hood installed at the bottom of the compressor.

Sound generation in a refrigeration or air conditioning system

Typical sound and vibration in refrigeration and air conditioning systems encountered by design and service engineers may be broken down into the following three source categories.
Sound radiation: this generally takes an airborne path.

Mechanical vibrations: these generally extend along the parts of the unit and structure.
Gas pulsation: this tends to travel through the cooling medium, i.e. the refrigerant.
The following sections focus on the causes and methods of mitigation for each of the above sources.

Compressor sound radiation

For sound radiating from the compressor, the emission path is airborne and the sound waves are travelling directly from the machine in all directions.
The VSH scroll compressor is designed to be quiet and the frequency of the sound generated is pushed into the higher ranges, which not only are easier to reduce but also do not generate the penetrating power of lower-frequency sound. Use of sound-insulation materials on the inside of unit panels is an effective means of substantially reducing the sound being transmitted to

the outside. Ensure that no components capable of transmitting sound/vibration within the unit come into direct contact with any non insulated parts on the walls of the unit.
Because of the VSH unique design of a full-suction gas-cooled motor, compressor body insulation across its entire operating range is possible. Acoustic hoods are available from Danfoss as accessories. These hoods are quick and easy to install and do not increase the overall size of the compressors to a great extend.

Mechanical vibrations

Vibration isolation constitutes the primary method for controlling structural vibration. VSH scroll compressors are designed to produce minimal vibration during operations. The use of rubber isolators on the compressor base plate or on the frame of a manifolded unit is very effective in reducing vibration being transmitted from the compressor(s) to the unit. Once the supplied rubber grommets have been properly mounted,

vibrations transmitted from the compressor base plate to the unit are held to a strict minimum. In addition, it is extremely important that the frame supporting the mounted compressor be of sufficient mass and stiffness to help dampen any residual vibration potentially transmitted to the frame. For further information on mounting requirements, please refer to the section on mounting assembly.

Speed by-pass

If vibrations occurs at some typical frequencies of the VSH variable speed compressor system, design must be checked: frame, piping, pipes using cushioned clamps. But if some frequencies remain showing unacceptable vibration level,

speed by-pass is adjustable in the frequency converter, in order to avoid some frequency ranges. Four by-pass ranges are adjustable, and settings can be done in parameters 4.6 *.

Gas pulsation

The VSH scroll compressor has been designed and tested to ensure that gas pulsation has been optimized for the most commonly encountered air conditioning pressure ratios. On heat pump installations and other installations where the pressure ratio lies beyond the typical range, testing should be conducted under all expected

conditions and operating configurations to ensure that minimum gas pulsation is present. If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass should be installed. This information can be obtained from the component manufacturer.

Application guidelines

Installation

Each compressor is shipped with printed instructions for installation. These instructions can also

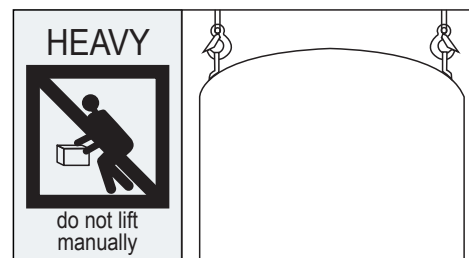
be downloaded from:
www.instructions.cc.danfoss.com

Compressor handling

Each VSH scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor. A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution. The use of lifting hooks closed with a clasp certified to lift the weight of the compressor is also highly recommended. Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors. Maintain the compressor in an upright position during all handling operations.

Never use only one lifting lug to lift the compressor. The compressor is too heavy for the single lug to handle, and the risk is that the lug could separate from the compressor with extensive damage and possible personal injury as a result.

When the compressor is mounted as part of an installation, never use the lift rings on the compressor to lift the installation. The risk is that the lugs could separate from the compressor or that the compressor could separate from the base frame with extensive damage and possible personal injury as a result.



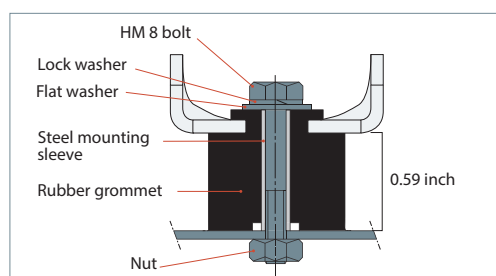
Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box can cause extensive damage to both the box and the components contained inside.

Mounting

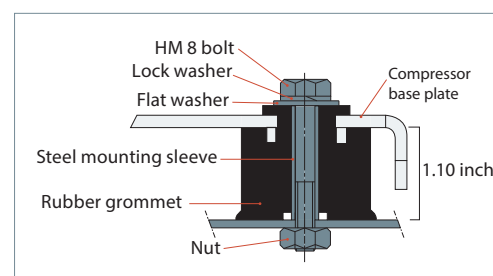
VSH compressors come delivered with four rubber mounting grommets and metal sleeve liners that serve to isolate the compressor from the base frame. These grommets must always be used to mount the compressor in a single appli-

cation. The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The grommets attenuate to a great extent the transmission of compressor vibrations to the base frame.

The required bolt size for the VSH 088 & 117 compressors is HM8-40. This bolt must be tightened to a torque of 11 ft.lb.



The required bolt size for VSH170 compressors is HM8-55 and must be tightened to a torque of 15 ft.lb.



Removing connections shipping plugs

Before the suction and discharge plugs are removed, the nitrogen holding charge must be released via the suction schrader valve to avoid an oil mist blowout. Remove the suction plug first and the discharge plug afterwards. The plugs shall be removed only just before connecting the

compressor to the installation in order to avoid moisture from entering the compressor. When the plugs are removed, it is essential to keep the compressor in an upright position so as to avoid oil spillage.

Application guidelines

Installation

System cleanliness

The refrigerant compression system, regardless of the type of compressor used, will only provide high efficiency and good reliability, along with a long operating life, if the system contains solely the refrigerant and oil it was designed for. Any other substances within the system will not improve performance and, in most cases, will be highly detrimental to system operations.

The presence of non-condensable substances and system contaminants such as metal shavings, solder and flux, have a negative impact on compressor service life. Many of these contaminants are small enough to pass through a mesh screen and can cause considerable damage within a bearing assembly.

The use of highly hygroscopic polyolester oil in R410A compressors requires that the oil be exposed to the atmosphere as little as possible. System contamination is one of main factors affecting equipment reliability and compressor service life. It is important therefore to take system cleanliness into account when assembling a refrigeration system. During the manufacturing process, circuit con-

tamination may be caused by:

- Brazing and welding oxides,
- Filings and particles from the removal of burrs in pipe-work,
- Brazing flux,
- Moisture and air.

Consequently, when building equipment and assemblies, the precautions listed in the following paragraphs must be taken.

Tubing

Only use clean and dehydrated refrigeration-grade copper tubing. Tube-cutting must be carried out so as not to deform the tubing roundness and to ensure that no foreign debris remains within the tubing. Only refrigerant grade fittings should be used and these must be of

both a design and size to allow for a minimum pressure drop through the completed assembly. Follow the brazing instructions below. Never drill holes into parts of the pipe-work where filings and particles can not be removed.

Filter driers

For new installations with VSH compressors with polyolester oil, Danfoss recommends using the Danfoss DML 100% molecular sieve, solid core filter drier. Molecular sieve filter driers with loose beads from third party suppliers shall be avoided. For servicing of existing installations where acid formation is present the Danfoss DCL solid core filter driers containing activated alumina are recommended.

The drier is to be oversized rather than undersized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigeration capacity and the system refrigerant charge.

Brazing and soldering

Copper to copper connections

When brazing copper-to-copper connections, the use of copper/phosphorus brazing alloy containing 5% silver or more with a melting temperature

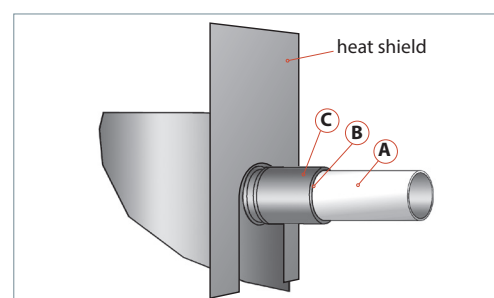
of below 1500°F is recommended. No flux is required during brazing.

Dissimilar metals connections

When manipulating dissimilar metals such as copper and brass or steel, the use of silver solder and anti-oxidant flux is necessary.

Compressor connection

When brazing the compressor fittings, do not overheat the compressor shell, which could severely damage certain internal components due to excessive heating. Use of a heat shield and/or a heat-absorbent compound is highly recommended. Due to the relatively sizable tubing and fitting diameters a double-tipped torch using acetylene is recommended for brazing operation on VSH compressors.



Application guidelines

Installation

For brazing the suction and discharge connections, the following procedure is advised:

- Make sure that no electrical wiring is connected to the compressor.
- Protect the terminal box and compressor painted surfaces from torch heat damage (see diagram).
- Remove the Teflon gaskets when brazing rotor-lock connectors with solder sleeves.
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Use brazing material with a minimum of 5% silver content.
- Purge nitrogen or CO₂ through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- Apply heat evenly to area A until the brazing temperature is reached. Move the torch to area B and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
- Move the torch to area C only long enough to draw the brazing material into the joint, but not into the compressor.

- Remove all remaining flux once the joint has been soldered with a wire brush or a wet cloth. Remaining flux would cause corrosion of the tubing.

Ensure that no flux is allowed to enter into the tubing or compressor. Flux is acidic and can cause substantial damage to the internal parts of the system and compressor.

The polyolester oil used in VSH compressors is highly hygroscopic and will rapidly absorb moisture from the air. The compressor must therefore not be left open to the atmosphere for a long period of time. The compressor fitting plugs shall be removed just before brazing the compressor. The compressor should always be the last component brazed into the system

Before eventual unbrazing the compressor or any system component, the refrigerant charge must be removed from both the high- and low-pressure sides. Failure to do so may result in serious personal injury. Pressure gauges must be used to ensure all pressures are at atmospheric level.

For more detailed information on the appropriate materials required for brazing or soldering, please contact the product manufacturer or distributor. For specific applications not covered herein, please contact Danfoss for further information.

System pressure test

Always use an inert gas such as nitrogen for pressure testing. Never use other gasses such as oxygen, dry air or acetylene as these may form an

inflammable mixture. Do not exceed the following pressures:

| | |
|---|--|
| Maximum compressor test pressure (low side) | 483 psig for VSH088 & 117 438 psig for VSH170 |
| Maximum compressor test pressure (high side) | 645 psig |
| Maximum pressure difference between high and low side of the compressor | 537 psi |

Pressurize the system on HP side first then LP side to prevent rotation of the scroll. Never let the

pressure on LP side exceed the pressure on HP side with more than 73 psig.

Leak detection

Leak detection must be carried out using a mixture of nitrogen and refrigerant or nitrogen and helium, as indicated in the table below. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture.

Pressurize the system on HP side first then LP side.

| Leak detection with refrigerant | Leak detection with a mass spectrometer |
|---------------------------------|---|
| Nitrogen & R410A | Nitrogen & Helium |

Application guidelines

Installation

Vacuum pump down and moisture removal

Moisture obstructs the proper functioning of both the compressor and the refrigeration system. Air and moisture reduce service life and increase condensation pressure, which causes abnormally high discharge temperatures that are then capable of degrading the lubricating properties of the oil. The risk of acid formation is also increased by air and moisture, and this

condition can also lead to copper plating. All these phenomena may cause both mechanical and electrical compressor failures. The typical method for avoiding such problems is a vacuum pump-down executed with a vacuum pump, thus creating a minimum vacuum of 500 microns (0.67 mbar). Please refer to News bulletin "Vacuum pump down and dehydration procedure".

Refrigerant charging

Air-conditioning installations exist in a multiple of designs and with many possible system components installed. The system design and the presence or absence of certain components, not only influence the system behaviour during operations; they can also be of a great influence during the refrigerant charging procedure. Improper charging procedure could cause compressor damage in several ways excessive LP/HP pressure differences, liquid slugging or vacuum operation. The below charge procedure is strongly recommended to reduce these risks.

- Prior to refrigerant charging a system vacuum and moisture removal procedure must have been carried out. (See previous paragraph)
- Always use a scale to measure actual refrigerant R410A charge quantity. Record system charge when completed.
- The refrigerant must be charged in the liquid phase for R410A.
- The refrigerant must be charged at the liquid side of the refrigeration circuit. The best charging location is the service shut-off valve at the liquid receiver outlet. When there is no liquid receiver, the charge must be done in the liquid line. When a liquid line solenoid valve (LLSV) is present, it must be closed (de-energised) and the charge location must be before the LLSV.
- If the system is equipped with an electronic expansion valve (EXV), this valve must be fully closed (opening degree: 0%).
- Loosely connect the service manifold HP hose to a gauge fitting on the liquid side as described above. Connect the LP hose to a fitting on the suction line as far away as possible from the compressor.
- The compressor must be off and prevented from starting inadvertently/automatically.
- If the system is equipped with a liquid line service shut-off valve, put this valve in an intermediate position (between front seat and back seat).
- Start the charging process:
 - > Using a charging machine the refrigerant charge specified can be achieved in one step
 - > If using a refrigerant cylinder, it can be warmed up carefully to avoid generating over pressure, but increase enough the tank pressure to allow the complete transfer.
 - > If neither EXV nor LLSV is present, take extra care not filling up the compressor sump with liquid refrigerant via the evaporator and suction line.
- "Crack" open the LP service gauge manifold valve. The pressure in the system LP side increase slowly until LP pressure equals HP pressure. The pressure increase at LP side shall not be faster than 0.25 bar/second. A brutal pressure increase can cause internal compressor damage because of an excessive LP/HP compressor side difference.
- Compressor can be started. Make sure the compressor is not going to run under vacuum. If this situation appears then manually stop and restart the compressor. When a EXV is used it can be prepositioned at given opening degree to avoid running at low evaporating during EXV self adjustment. Never by-pass the LP pressure switch.
- Allow the system to operate until the design operating temperature has been achieved before making final refrigerant charge adjustment.
- The additional refrigerant charge must be done on the LP side by slowly throttling through the Schrader fitting.
- Continue to monitor the system closely throughout the entire, initial pull-down period. Observe all operating system pressures and temperatures and make any other necessary control adjustments. During this time, the compressor oil level should be maintained within the sight glass and suction superheat measured at the compressor

Application guidelines

Installation

suction to ensure adequate motor cooling and no liquid refrigerant is being returned directly to the compressor.

Commissioning

The system must be monitored after initial start-up for a minimum of 60 minutes to ensure proper operating characteristics such as:

- Proper metering device operation and desired superheat readings
- Suction and discharge pressure are within acceptable levels
- Correct oil level in compressor sump indicating proper oil return
- Low foaming in sight glass and compressor sump temperature 18°F above saturation temperature to show that there is no refrigerant migration taking place
- Acceptable cycling rate of compressors, including duration of run times

A short cycling protection is provided in the CDS302 frequency converter. It is factory preset "enabled" with the following parameters in:

28.01 interval between 2 starts: 300 secondes
28.02 minimum run time: 12 seconds

This minimum run time is set to guaranty long enough running time at start up in order to create enough refrigerant flow velocity in the system to recover the oil to the compressor sump.

- Current draw of compressor within acceptable values (RLA ratings)
- No abnormal vibrations and noise.

Optional relay card

In some situation, an optional relay card is needed and installed on the frequency converter. This will give access to extra parameters that will have to be set according to the application needs. These settings can be done directly to the frequency converter or downloaded to it (via a LCP for example).

Afterwards, if the relay card is removed and the frequency converter is powered-up without the relay card in place, the settings will be loosed and reset to factory settings. Therefore, during commissioning or card replacement, it is important to not power-up the frequency converter while the relay card is not in place.

Oil level checking and top-up

In installations with good oil return and line runs up to 66 ft, no additional oil is required. If installation lines exceed 66 ft, additional oil may be needed. 1 or 2% of the total system refrigerant charge (in weight) can be used to roughly define the required oil top-up quantity but in any case the oil charge has to be adjusted based on the oil level in the compressor sight glass.

When the compressor is running under stabilized conditions the oil level must be visible in the sight glass.

The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor.

The oil level can also be checked a few minutes after the compressor stops, the level must be between ¼ and ¾ of sight glass.

When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

Always use original Danfoss POE oil 160SZ from new cans.

Top-up the oil while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line and a suitable pump. See News bulletin «Lubricants filling in instructions for Danfoss Commercial Compressors».

Application guidelines

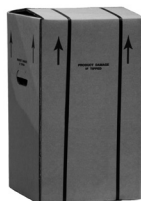
Ordering information and packaging

Kit ordering and shipping

The tables on the following pages give code numbers for ordering purposes for the VSH compressor and CDS302 frequency converter kit packed and shipped separately.

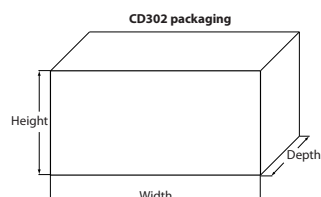
Packaging

Compressor single pack



| Compressor model | Height (inch) | Width (inch) | Depth (inch) | Weight (lb) |
|------------------|---------------|--------------|--------------|-------------|
| VSH088 | 22.8 | 17.9 | 14.0 | 130 |
| VSH117 | 22.8 | 17.9 | 14.0 | 143 |
| VSH170 | 30.1 | 20.3 | 17.7 | 234 |

Frequency converter single pack



| Drive supply voltage | Drive power (kW) | IP20 | | | | IP55 | | | |
|----------------------|------------------|---------------|--------------|--------------|-------------|---------------|--------------|--------------|-------------|
| | | Height (inch) | Width (inch) | Depth (inch) | Weight (lb) | Height (inch) | Width (inch) | Depth (inch) | Weight (lb) |
| T2 | 15 | 13.6 | 31.9 | 12.6 | 53 | 16.9 | 31.7 | 15.9 | 101 |
| | 18 - 22 | 17.2 | 31.7 | 15.9 | 79 | 17.2 | 31.7 | 15.9 | 101 |
| T4 | 15 | 13.7 | 19.7 | 13.0 | 29 | 13.6 | 31.9 | 12.6 | 53 |
| | 18 - 22 | 13.6 | 31.9 | 12.6 | 53 | 13.6 | 31.9 | 12.6 | 62 |
| T6 | 15 | 13.7 | 19.7 | 13.0 | 29 | 13.6 | 31.9 | 12.6 | 53 |
| | 18 - 22 | 13.6 | 31.9 | 12.6 | 53 | 13.6 | 31.9 | 12.6 | 62 |

VSH voltage code J - 200-240 Volt

| Compressor | | Frequency converter | | | | | |
|------------|----------------------|---------------------|-----|----------|-----------|----------|----------------------|
| Model | Code n° for ordering | Model & power | LCP | IP class | RFI class | Coating | Code n° for ordering |
| VSH088-J | 120G0004 | CDS302 15.0kW | No | IP20 | H3 | no | 131H9122 |
| | | | | | H3 | Yes | 131H9123 |
| | | | | H2 | No | 131H9124 | |
| | | | | | Yes | 131H9125 | |
| | | | Yes | IP55 | H3 | no | 131H9127 |
| | | | | | H3 | Yes | 131H9128 |
| | | | | H2 | No | 131H9129 | |
| | | | | | Yes | 131H9130 | |
| | | | Yes | IP20 | H3 | no | 131F5246 |
| | | | | | H3 | yes | 131H9131 |
| | | | | H2 | no | 131H9132 | |
| | | | | | yes | 131H9133 | |
| VSH117-J | 120G0005 | CDS302 18.5kW | No | IP20 | H3 | no | 131H9138 |
| | | | | | H3 | Yes | 131H9139 |
| | | | | H2 | No | 131H9140 | |
| | | | | | Yes | 131H9141 | |
| | | | Yes | IP55 | H3 | no | 131H9142 |
| | | | | | H3 | Yes | 131H9143 |
| | | | | H2 | No | 131H9144 | |
| | | | | | Yes | 131H9145 | |
| | | | Yes | IP20 | H3 | no | 131F0395 |
| | | | | | H3 | yes | 131H9146 |
| | | | | H2 | no | 131H9147 | |
| | | | | | yes | 131H9148 | |
| VSH170-J | 120G0006 | CDS302 22.0 kW | No | IP20 | H3 | no | 131H9153 |
| | | | | | H3 | Yes | 131H9154 |
| | | | | H2 | No | 131H9155 | |
| | | | | | Yes | 131H9156 | |
| | | | Yes | IP55 | H3 | no | 131H9157 |
| | | | | | H3 | Yes | 131H9158 |
| | | | | H2 | No | 131H9159 | |
| | | | | | Yes | 131H9160 | |
| | | | Yes | IP20 | H3 | no | 131F0394 |
| | | | | | H3 | yes | 131H9161 |
| | | | | H2 | no | 131H9162 | |
| | | | | | yes | 131H9163 | |
| | | | | IP55 | H3 | no | 131H9164 |
| | | | | | H3 | yes | 131H9165 |
| | | | | H2 | no | 131H9166 | |
| | | | | | yes | 131H9167 | |

VSH voltage code G - 380-480 Volt

| Compressor | | Frequency converter | | | | | |
|------------|----------------------|---------------------|-----|----------|-----------|---------|----------------------|
| Model | Code n° for ordering | Model & power | LCP | IP class | RFI class | Coating | Code n° for ordering |
| VSH088-G | w120G0001 | CDS302 15.0kW | No | IP20 | H3 | no | 131H4380 |
| | | | | | H3 | Yes | 131H9079 |
| | | | | H2 | No | No | 131H9078 |
| | | | | | H2 | Yes | 131H9080 |
| | | | Yes | IP55 | H3 | no | 131H9081 |
| | | | | | H3 | Yes | 131H9082 |
| | | | | H2 | No | No | 131H9083 |
| | | | | | H2 | Yes | 131H9084 |
| | | | Yes | IP20 | H3 | no | 131B8789 |
| | | | | | H3 | yes | 131H9085 |
| | | | | H2 | no | No | 131H9086 |
| | | | | | H2 | yes | 131H9087 |
| VSH117-G | 120G0002 | CDS302 18.5kW | No | IP20 | H3 | no | 131H4381 |
| | | | | | H3 | Yes | 131H9092 |
| | | | | H2 | No | No | 131H9093 |
| | | | | | H2 | Yes | 131H9094 |
| | | | Yes | IP55 | H3 | no | 131H9098 |
| | | | | | H3 | Yes | 131H9095 |
| | | | | H2 | No | No | 131H9096 |
| | | | | | H2 | Yes | 131H9097 |
| | | | Yes | IP20 | H3 | no | 131F5247 |
| | | | | | H3 | yes | 131H9099 |
| | | | | H2 | no | No | 131H9100 |
| | | | | | H2 | yes | 131H9102 |
| VSH170-G | 120G0003 | CDS302 22.0 kW | No | IP20 | H3 | no | 131H4382 |
| | | | | | H3 | Yes | 131H9107 |
| | | | | H2 | No | No | 131H9108 |
| | | | | | H2 | Yes | 131H9109 |
| | | | Yes | IP55 | H3 | no | 131H9110 |
| | | | | | H3 | Yes | 131H9111 |
| | | | | H2 | No | No | 131H9112 |
| | | | | | H2 | Yes | 131H9113 |
| | | | Yes | IP20 | H3 | no | 131F5248 |
| | | | | | H3 | yes | 131H9114 |
| | | | | H2 | no | No | 131H9116 |
| | | | | | H2 | yes | 131H9117 |
| | | | Yes | IP55 | H3 | no | 131H9118 |
| | | | | | H3 | yes | 131H9119 |
| | | | Yes | H2 | no | No | 131H9120 |
| | | | | | H2 | yes | 131H9121 |

VSH voltage code H - 525-600 Volt

| Compressor | | Frequency converter | | | | | |
|------------|----------------------|---------------------|----------|----------|-----------|----------|----------------------|
| Model | Code n° for ordering | Model & power | LCP | IP class | RFI class | Coating | Code n° for ordering |
| VSH088-H | 120G0007 | CDS302 15.0kW | No | IP20 | HX | no | 131N3583 |
| | | | | | | Yes | 131N6978 |
| | | | | IP55 | HX | no | 131N6979 |
| | | | Yes | | | 131N6980 | |
| | | | Yes | IP20 | HX | no | 131N6981 |
| | | | | | | yes | 131N6982 |
| IP55 | HX | no | | 131N6983 | | | |
| | | yes | 131N6984 | | | | |
| VSH117-H | 120G0008 | CDS302 18.5kW | No | IP20 | HX | no | 131N6985 |
| | | | | | | Yes | 131N6986 |
| | | | | IP55 | HX | no | 131N6987 |
| | | | Yes | | | 131N6988 | |
| | | | Yes | IP20 | HX | no | 131N6989 |
| | | | | | | yes | 131N6990 |
| IP55 | HX | no | | 131N6991 | | | |
| | | yes | 131N6992 | | | | |
| VSH170-H | 120G0009 | CDS302 22.0 kW | No | IP20 | HX | no | 131N6993 |
| | | | | | | Yes | 131N6994 |
| | | | | IP55 | HX | no | 131N6996 |
| | | | Yes | | | 131N6997 | |
| | | | Yes | IP20 | HX | no | 131N6998 |
| | | | | | | yes | 131N6999 |
| IP55 | HX | no | | 131N7000 | | | |
| | | yes | 131N7001 | | | | |

Application guidelines Accessories

Valves, adapters, connectors & gaskets for use on suction and discharge connections

Solder sleeve adapter sets

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|-------------|-----------|-----------|
| | 120Z0125 | Solder sleeve adapter set (1"3/4 Rotolock, 1"1/8 ODF), (1"1/4 Rotolock, 7/8" ODF) | VSH088 | Multipack | 8 |
| | 120Z0405 | Solder sleeve adapter set (1"3/4 rotolock, 1"3/8 ODF), (1"1/4 rotolock, 7/8" ODF) | VSH117 | Multipack | 8 |
| | 7765028 | Solder sleeve adapter set, (2"1/4 Rotolock, 1"5/8 ODF), (1"3/4 Rotolock, 7/8" ODF) | VSH170 | Multipack | 6 |

Rotolock adapter

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|--|-----------|-----------|
| | 120Z0367 | Rotolock adapter (1"1/4" Rotolock, 7/8" ODF) | VSH 088-117 (Discharge side) | Multipack | 10 |
| | 120Z0364 | Rotolock adapter (1"3/4 Rotolock, 1"1/8 ODF) | VSH 088 (Suction side) VSH 170 (Discharge side) | Multipack | 10 |
| | 120Z0431 | Rotolock adapter (1"3/4 Rotolock, 1"3/8 ODF) | VSH 117 (Suction side) | Multipack | 10 |
| | 120Z0432 | Rotolock adapter (2"1/4 Rotolock, 1"5/8 ODF) | VSH 170 (Suction side) | Multipack | 10 |

Gaskets and gasket set

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|---------|--|---------------------------------------|---------------|-----------|
| G07 | 8156132 | Gasket, 1"3/4 | Models with 1"3/4 rotolock connection | Multipack | 10 |
| G07 | 7956003 | Gasket, 1"3/4 | Models with 1"3/4 rotolock connection | Industry pack | 50 |
| G08 | 8156133 | Gasket, 2"1/4 | Models with 2"1/4 rotolock connection | Multipack | 10 |
| G08 | 7956004 | Gasket, 2"1/4 | Models with 2"1/4 rotolock connection | Industry pack | 50 |
| | 8156013 | Gasket set, 1"1/4, 1"3/4, 2"1/4, OSG gaskets black & white | All rotolock models | Multipack | 10 |

Solder sleeves

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|---------|--|---------------------------------------|---------------|-----------|
| P02 | 8153004 | Solder sleeve, P02 (1"3/4 Rotolock, 1"1/8 ODF) | Models with 1"3/4 rotolock connection | Multipack | 10 |
| P02 | 7953005 | Solder sleeve, P02 (1"3/4 Rotolock, 1"1/8 ODF) | Models with 1"3/4 rotolock connection | Industry pack | 50 |
| P10 | 8153003 | Solder sleeve, P10 (1"3/4 Rotolock, 1"3/8 ODF) | Models with 1"3/4 rotolock connection | Multipack | 10 |
| P03 | 8153006 | Solder sleeve, P03 (2"1/4 Rotolock, 1"5/8 ODF) | Models with 2"1/4 rotolock connection | Multipack | 10 |
| P03 | 7953006 | Solder sleeve, P03 (2"1/4 Rotolock, 1"5/8 ODF) | Models with 2"1/4 rotolock connection | Industry pack | 50 |

Rotolock nuts

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|---------------------|---------------------------------------|---------------|-----------|
| | 8153124 | Rotolock nut, 1"3/4 | Models with 1"3/4 rotolock connection | Multipack | 10 |
| | 7953003 | Rotolock nut, 1"3/4 | Models with 1"3/4 rotolock connection | Industry pack | 50 |
| | 8153126 | Rotolock nut, 2"1/4 | Models with 2"1/4 rotolock connection | Multipack | 10 |
| | 120Z0047 | Rotolock nut, 2"1/4 | Models with 2"1/4 rotolock connection | Industry pack | 50 |

Rotolock service valves and valve sets (without gasket)

| Type | Code n° | Description | Application | Packaging | Pack size |
|---------|----------|--|---------------------------------------|---------------|-----------|
| V05 | 8168030 | Rotolock valve, V05 (1"1/4 Rotolock, 7/8" ODF) | Models with 1"1/4 rotolock connection | Multipack | 6 |
| V05 | 7968007 | Rotolock valve, V05 (1"1/4 Rotolock, 7/8" ODF) | Models with 1"1/4 rotolock connection | Industry pack | 36 |
| V02 | 8168028 | Rotolock valve, V02 (1"3/4 Rotolock, 1"1/8 ODF) | Models with 1"3/4 rotolock connection | Multipack | 6 |
| V02 | 7968009 | Rotolock valve, V02 (1"3/4 Rotolock, 1"1/8 ODF) | Models with 1"3/4 rotolock connection | Industry pack | 24 |
| V10 | 8168022 | Rotolock valve, V10 (1"3/4 Rotolock, 1"3/8 ODF) | Models with 1"3/4 rotolock connection | Single pack | 1 |
| V03 | 8168026 | Rotolock valve, V03 (2-1/4" Rotolock, 1"5/8 ODF) | Models with 2"1/4 rotolock connection | Multipack | 6 |
| V03 | 7968011 | Rotolock valve, V03 (2-1/4" Rotolock, 1"5/8 ODF) | Models with 2"1/4 rotolock connection | Industry pack | 18 |
| V02-V05 | 7703008 | Valve set, V02(1"3/4~1"1/8), V05(1"1/4~7/8") | VSH088 | Multipack | 6 |
| V02-V05 | 120Z0403 | Valve set, V02(1"3/4~1"1/8), V05(1"1/4~7/8") | VSH088 | Multipack | 8 |
| V10-V05 | 7703392 | Valve set, V10 (1"3/4~1"3/8), V05 (1"1/4~7/8") | VSH117 | Multipack | 6 |
| V03-V02 | 7703383 | Valve set, V03 (2-1/4"~1"5/8), V02 (1"3/4~1"1/8) | VSH170 | Multipack | 4 |

Rotolock angle adapters and sets

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|---------|--|---------------------------------------|-----------|-----------|
| C03 | 8168006 | Angle adapter, C04 (1"1/4 Rotolock, 3/4" ODF) | Models with 1"1/4 rotolock connection | Multipack | 6 |
| C07 | 8168008 | Angle adapter, C07 (1"3/4 Rotolock, 7/8" ODF) | Models with 1"3/4 rotolock connection | Multipack | 6 |
| C02 | 8168005 | Angle adapter, C02 (1"3/4 Rotolock, 1"1/8 ODF) | Models with 1"3/4 rotolock connection | Multipack | 6 |

Crankcase heaters & thermostats

Crankcase heaters

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|-------------|---------------|-----------|
| | 7773109 | Belt type crankcase heater, 65 W, 110 V, CE mark, UL | VSH088-117 | Multipack | 6 |
| | 7973001 | Belt type crankcase heater, 65 W, 110 V, CE mark, UL | | Industry pack | 50 |
| | 7773107 | Belt type crankcase heater, 65 W, 230 V, CE mark, UL | | Multipack | 6 |
| | 120Z0038 | Belt type crankcase heater, 65 W, 230 V, CE mark, UL | | Multipack | 8 |
| | 7973002 | Belt type crankcase heater, 65 W, 230 V, CE mark, UL | | Industry pack | 50 |
| | 7773117 | Belt type crankcase heater, 65 W, 400 V, CE mark, UL | | Multipack | 6 |
| | 120Z0039 | Belt type crankcase heater, 65 W, 400 V, CE mark, UL | | Multipack | 8 |
| | 120Z0466 | Belt type crankcase heater, 65 W, 460 V, CE mark, UL | | Multipack | 6 |
| | 120Z0467 | Belt type crankcase heater, 65 W, 575 V, CE mark, UL | VSH170 | Multipack | 6 |
| | 7773110 | Belt type crankcase heater, 75 W, 110 V, CE mark, UL | | Multipack | 6 |
| | 7773108 | Belt type crankcase heater, 75 W, 230 V, CE mark, UL | | Multipack | 6 |
| | 7773118 | Belt type crankcase heater, 75 W, 400 V, CE mark, UL | | Multipack | 6 |

Surface sump heaters

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|-------------|-----------|-----------|
| | 120Z0388 | Surface sump heater, 80 W, 24 V, CE, UL | VSH088-117 | Multipack | 8 |
| | 120Z0389 | Surface sump heater, 80 W, 230 V, CE, UL | | Multipack | 8 |
| | 120Z0390 | Surface sump heater, 80 W, 400 V, CE, UL | | Multipack | 8 |
| | 120Z0391 | Surface sump heater, 80 W, 460 V, CE, UL | | Multipack | 8 |
| | 120Z0402 | Surface sump heater, 80 W, 575 V, CE, UL | | Multipack | 8 |
| | 120Z0360 | Surface sump heater + bottom insulation, 56 W, 24 V, CE, UL | VSH170 | Multipack | 6 |
| | 120Z0376 | Surface sump heater + bottom insulation, 56 W, 230 V, CE, UL | | Multipack | 6 |
| | 120Z0377 | Surface sump heater + bottom insulation, 56 W, 400 V, CE, UL | | Multipack | 6 |
| | 120Z0378 | Surface sump heater + bottom insulation, 56 W, 460 V, CE, UL | | Multipack | 6 |
| | 120Z0379 | Surface sump heater + bottom insulation, 56 W, 575 V, CE, UL | | Multipack | 6 |

Application guidelines Accessories

Discharge thermostats and sensors

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|----------------|---------------|-----------|
| | 120Z0157 | Discharge temperature sensor / converter kit | VSH all models | Single pack | 1 |
| | 120Z0158 | Discharge temperature sensor | VSH all models | Single pack | 1 |
| | 120Z0159 | Discharge temperature converter | VSH all models | Single pack | 1 |
| | 7750009 | Discharge thermostat kit | VSH all models | Multipack | 10 |
| | 7973008 | Discharge thermostat kit | VSH all models | Industry pack | 50 |

Lubricant , acoustic hoods and spareparts

Acoustic hoods

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|--------------|-------------|-----------|
| | 120Z0152 | Acoustic hood for VSD Scroll compressors | VSH088-G/H | Single pack | 1 |
| | 120Z0153 | Acoustic hood for VSD Scroll compressors | VSH117-G/H | Single pack | 1 |
| | 120Z0154 | Acoustic hood for VSD Scroll compressors | VSH170-G/H/J | Single pack | 1 |
| | 120Z0155 | Acoustic hood for VSD Scroll compressors | VSH088-J | Single pack | 1 |
| | 120Z0156 | Acoustic hood for VSD Scroll compressors | VSH117-J | Single pack | 1 |

Mounting kits

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|--|-------------|-------------|-----------|
| | 120Z0066 | Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers | VSH088-117 | Single pack | 1 |
| | 8156138 | Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers | VSH170 | Single pack | 1 |

Terminal boxes, covers & T-block connectors

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|------------------------------|------------------------------|-------------|-----------|
| | 8173230 | T block connector 52 x 57 mm | VSH088-G/H.VSH117-G/H | Multipack | 10 |
| | 8173021 | T block connector 60 x 75 mm | VSH088-J.VSH117-J.VSH170-G/H | Multipack | 10 |
| | 8173331 | T block connector 80 x 80 mm | VSH170-J | Multipack | 10 |
| | 120Z0146 | Electrical box | VSH088-G/H.VSH117-G/H | Single pack | 1 |
| | 120Z0147 | Electrical box | VSH170-G/H/J | Single pack | 1 |
| | 120Z0148 | Electrical box | VSH088-117-J | Single pack | 1 |
| | 120Z0149 | Electrical box cover | VSH088-G/H.VSH117-G/H | Single pack | 1 |
| | 120Z0150 | Electrical box cover | VSH170-G/H/J | Single pack | 1 |
| | 120Z0151 | Electrical box cover | VSH088-117-J | Single pack | 1 |

Coil

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|-------------|----------------|-------------|-----------|
| | 120Z0143 | Coil / 230V | VSH all models | Single pack | 1 |
| | 120Z0144 | Coil / 24V | VSH all models | Single pack | 1 |

Valve Body

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|-------------|----------------|-------------|-----------|
| | 120Z0145 | Valve body | VSH all models | Single pack | 1 |

Application guidelines

Accessories

Lubricant / oils

| Type | Code n° | Description | Application | Packaging | Pack size |
|-------|---------|-----------------------------------|----------------|-----------|-----------|
| 160SZ | 7754023 | POE lubricant, 160SZ, 1 litre can | VSH with R410A | Multipack | 12 |
| 160SZ | 7754024 | POE lubricant, 160SZ, 2 litre can | VSH with R410A | Multipack | 8 |

Miscellaneous

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|---------|--|----------------|---------------|-----------|
| | 8156019 | Oil sight glass with gaskets (black & white) | VSH all models | Multipack | 4 |
| | 8156129 | Gasket for oil sight glass (white teflon) | VSH all models | Multipack | 10 |
| | 7956005 | Gasket for oil sight glass (white teflon) | VSH all models | Industry pack | 50 |
| | 8154001 | Danfoss CC blue spray paint | VSH all models | Single pack | 1 |

Spare parts frequency converter

LCP's

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|-----------------|----------------------------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 120Z0326 | 130B1107 | LCP | Frequency converter / all models | Single pack | 1 |
| 120Z0327 | 175Z0929 | RS cable to LCP | Frequency converter / all models | Single pack | 1 |
| 120Z0468 | 130B1088 | LCP Blind cover | Frequency converter IP20/IP21 | Single pack | 1 |
| 120Z0469 | 130B1077 | LCP Blind cover | Frequency converter IP55/IP66 | Single pack | 1 |

Fans

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|-----------------------|-------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 130B3563 | 120Z0328 | Fan 1 (main) IP20 | 15 kW | Single pack | 1 |
| 130B3699 | 120Z0329 | Fan 1 (main) IP20 | 18,5 -22 kW | Single pack | 1 |
| 130B3407 | 120Z0331 | Fan 1 (main) IP55 | 15 kW | Single pack | 1 |
| 130B3406 | 120Z0332 | Fan 1 (main) IP55 | 18,5 -22 kW | Single pack | 1 |
| 130B3440 | 120Z0334 | Fan 2 (internal) IP55 | 15 kW | Single pack | 1 |
| 130B3441 | 120Z0335 | Fan 2 (internal) IP55 | 18,5 -22 kW | Single pack | 1 |

Control card

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|--------------|----------------------------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 120Z0337 | 130B1109 | Control card | Frequency converter / all models | Single pack | 1 |

Power cards

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|-----------------|-------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 120Z0338 | 130B1942 | Power card IP20 | 15 kW | Single pack | 1 |
| 120Z0339 | 130B1943 | Power card IP20 | 18,5 kW | Single pack | 1 |
| 120Z0340 | 130B1944 | Power card IP20 | 22 kW | Single pack | 1 |
| 120Z0341 | 130B1842 | Power card IP55 | 15 kW | Single pack | 1 |
| 120Z0342 | 130B1823 | Power card IP55 | 18,5 kW | Single pack | 1 |
| 120Z0343 | 130B1825 | Power card IP55 | 22 kW | Single pack | 1 |

Application guidelines Accessories

Accessory bags

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|--------------------|--------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 120Z0344 | 130B0980 | Accessory bag IP20 | 15 - 18.5 kW | Single pack | 1 |
| 120Z0346 | 130B1300 | Accessory bag IP20 | 22 kW | Single pack | 1 |
| 120Z0347 | 130B2060 | Accessory bag IP55 | 15 - 18.5 kW | Single pack | 1 |
| 120Z0349 | 130B2061 | Accessory bag IP55 | 22 kW | Single pack | 1 |

Relays card

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|-------------|---------------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 120Z0350 | 130B1110 | Relays card | Frequency converter | Single pack | 1 |

Converters

| Type | Code n° | Description | Application | Packaging | Pack size |
|------|----------|-----------------------|---------------------|-------------|-----------|
| | 120Z0351 | RS232/RS485 Converter | Frequency converter | Single pack | 1 |
| | 120Z0352 | USB/RS485 Converter | Frequency converter | Single pack | 1 |

Switch mode power modules

| Code n° | | Description | Application | Packaging | Pack size |
|------------|------------|--------------------------------|-------------|-------------|-----------|
| Until 2011 | After 2011 | | | | |
| 120Z0418 | 130B1843 | Switch. mode power module IP55 | 18,5 kW | Single pack | 1 |
| 120Z0419 | 130B1844 | Switch. mode power module IP55 | 22 kW | Single pack | 1 |

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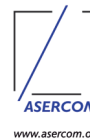
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